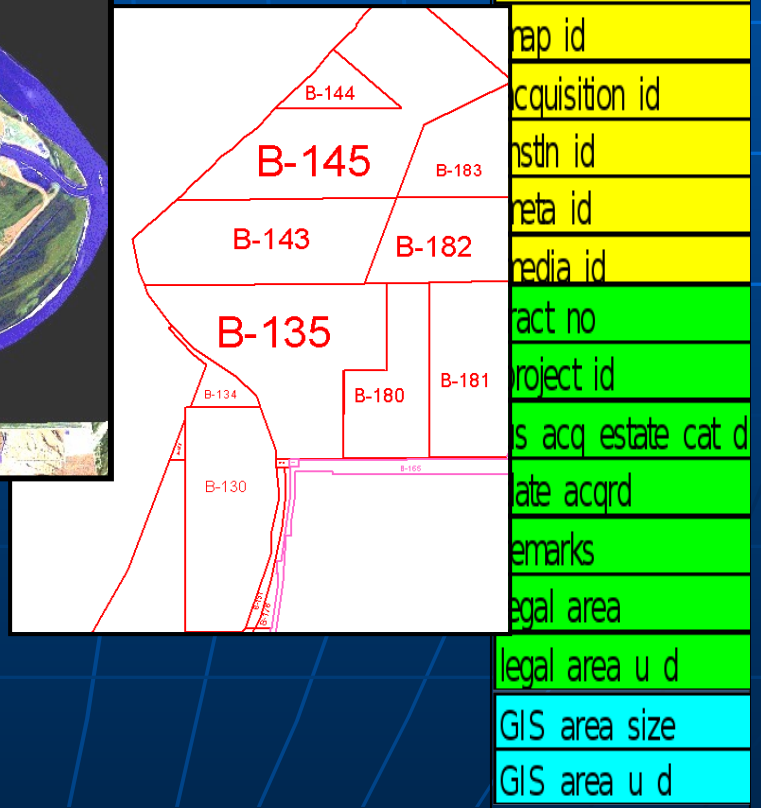
US Army Corps of Engineers

Real Estate Data & GIS



Linda Peyman Dove, ERDC-EL

Mark Gonyo, ERDC-EL

US Army Corps of Engineers

Products

- Completed 2001-2002 for Geospatial Technology Research and Development Program
  - Developed Real Estate/GIS Database Design
  - Assessed data conversion issues
  - Developed software tool to link Real Estate GIS to REMIS
  - Implemented at prototype site

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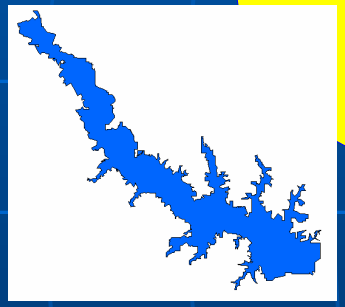
Database Design

Geographic Data



Attrbute Data

529001	1	Shuteye Br	529001	19	Mu
529001	36N	Frk South Fabius	529001	54	Da
529001	71	Hickory Northern	529001	89	St
529001	106	Dogwood Road	529001	124E	Po
529001	141	Meadow Ave	529001	159W	Ma
529001	176E	Hickory St	529001	194E	Wa
529001	211N	Don St	529001	229N	Ma
529001	246S	Cottage Grove St	529001	264E	Br
529001	281E	Link Dr	529001	299	Be
529001	316	Clg Park St	529001	334	Lo
529001	351	Brushy nut	529001	369	El
529001	386	Surratt			

Figure 5. A portion of a census data file containing address information.

Tabular

Activities and Business Programs

Real Estate GIS Database Design

CADD/GIS Spatial Data Standard (SDS)

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Coordination

- Workshops
  - Real Estate, Operations, Planning, Information Management
- Headquarters, Division, District and Field
- HQ REMIS proponent - Fred Lombardo
- REMIS database administrator - Donna Casey
- CADD/GIS Technology Center - Nancy Towne
- Reviewed existing standards

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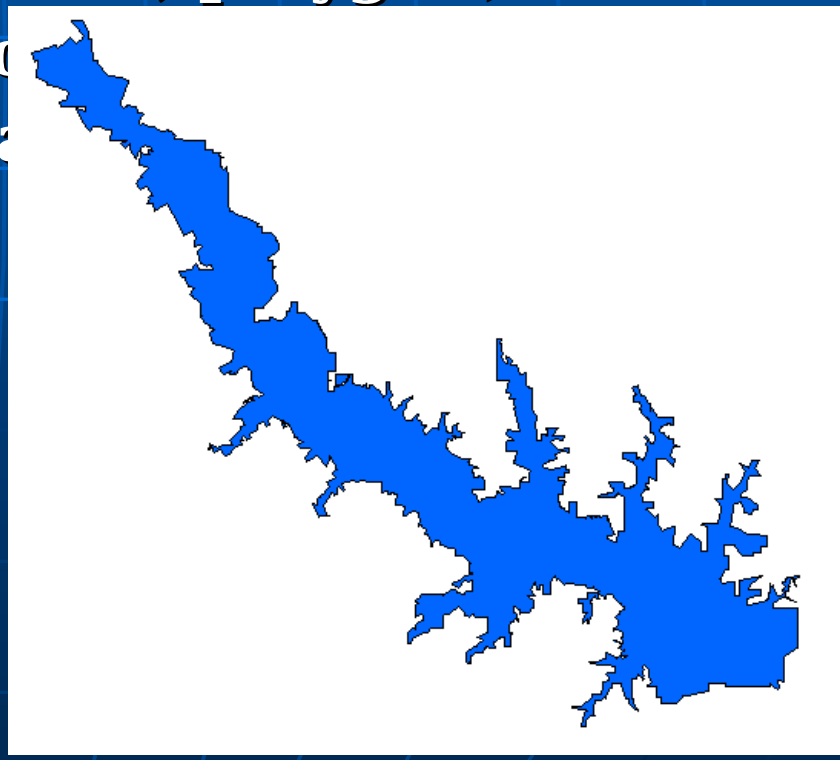
Geographic Layers

- **Boundary**
  - Fee boundary (polygon)
  - Outgrant boundary (point, polygon)
  - Disposal boundary (po
  - Encroachment bounda
  (point, polygon)
- **Tract**
  - Fee and less-than-fee (polygon)



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Tabular Design

- **Primary table for each layer**
  - **Robust (contains information needed by most users)**
  - **Standalone**
  - **Capitalize on existing REMIS database**

529001	1	Shuteye Br	529001	19	Mu
529001	36N	Frk South	Fabius 529001	54	Da
529001	71	Hickory Northern	529001	89	St
529001	106	Dogwood Road	529001	124E	Po
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529001	316	Clg Park St	529001	334	Lo
529001	351	Brushy nut	529001	369	El
529001	386	Surratt			

Figure 5. A portion of a census data file containing address information.

Non-spatial database - REMIS

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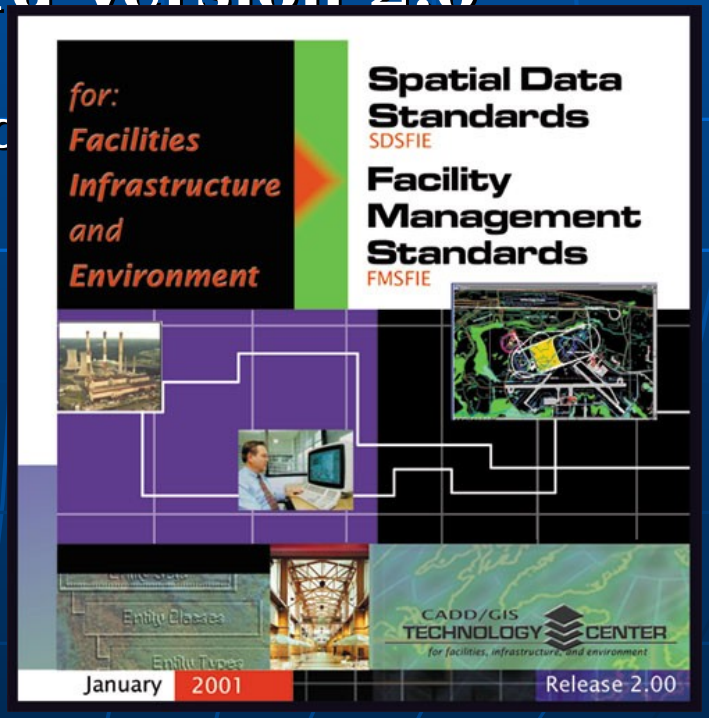
CADD/GIS Technology Center Spatial Data Standards

- **Incorporated cadastre real estate database design**
  into Spatial Data Standard Version 2.0
  - **Added five tables**
    - **Fee and less-than-fee trac**
    - **Outgrants**
    - **Encroachments**
    - **Disposals**
    - **Fee boundary**



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Outgrant Boundary Table

Outgrant Boundary

datalink
map_id
outgrant_id
project_id
instln_id
meta_id
media_id
contract_number
outgrant_purpose_d
outgrant_type_d
outgrant_row_type_d
permit_type_d
outgrant_status
effective_date
expiration_date
scheduled_inspect_date
actual_inspect_date
last_inspect_date
compliance_ind_d
inspector
grantee_number
grantee_name
remarks
narrative
legal_area
legal_area_u_d
GIS_area_size
GIS_area_u_d

Links to other files (relational database)

Domain Table
Lease
Easement
Permit
License
Right of Entry

Domain Table
Agriculture
Fish-Wildlife
Grazing
Right-of-Way

Standalone high value attributes
- frequent use at field level
- REMIS

Computer generated attributes

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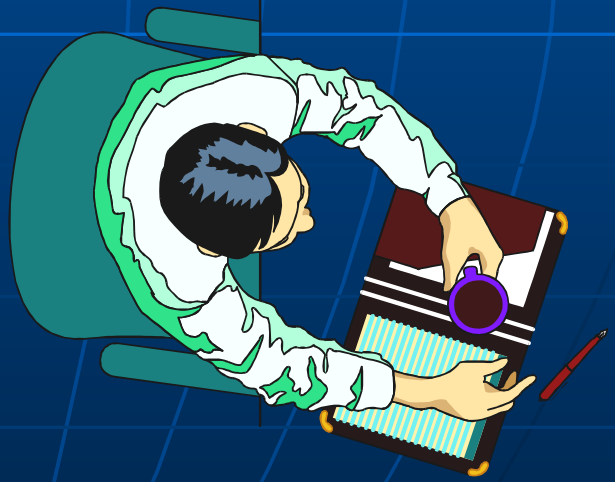
Data Conversion

- Hardcopy maps / Written surveys
  - Coordinate geometry (COGO)
  - Scanning and heads up digitizing
  - Table digitizing
  - Convert existing CADD/GIS files



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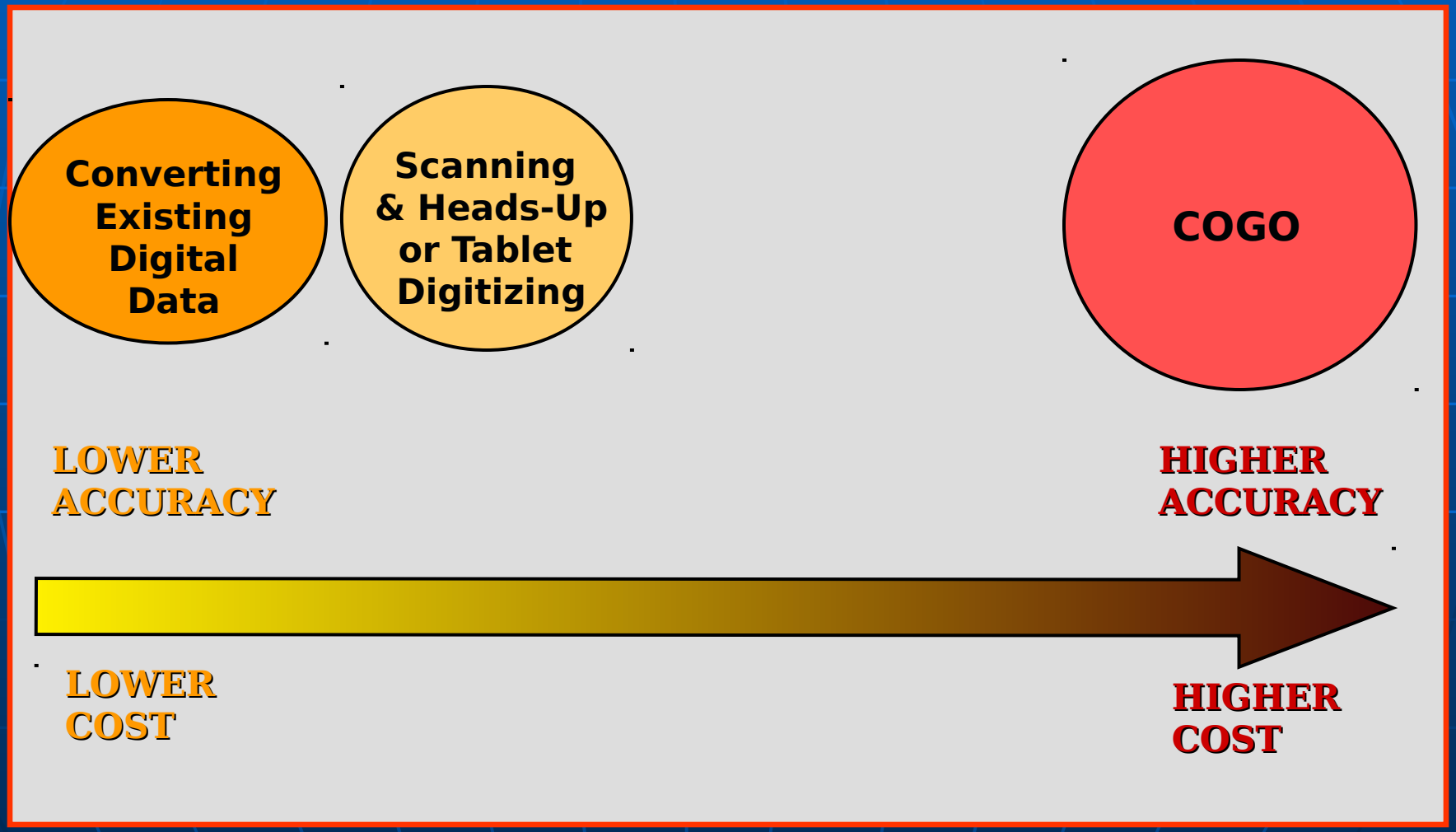
Conversion Methods



Coordinate Geometry

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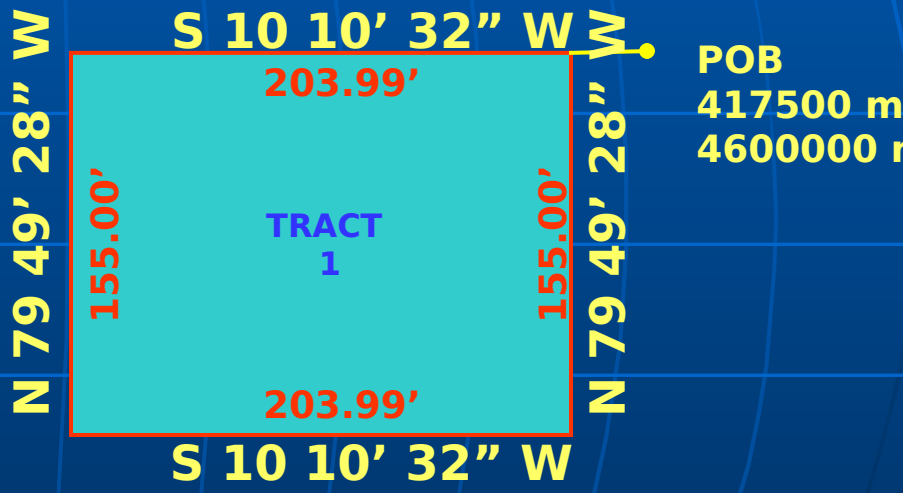
- Survey data entered primarily as set of bearings, distance and curve parameters
- POB in real world coordinates:
  - High positional accuracy
  - Precisely shaped tracts or polygons
- POB <u>not</u> in real world coordinates
  - Register with another data source
  - Precisely shaped tracts or polygons <u>BUT</u> positional reference missing



US Army Corps of Engineers

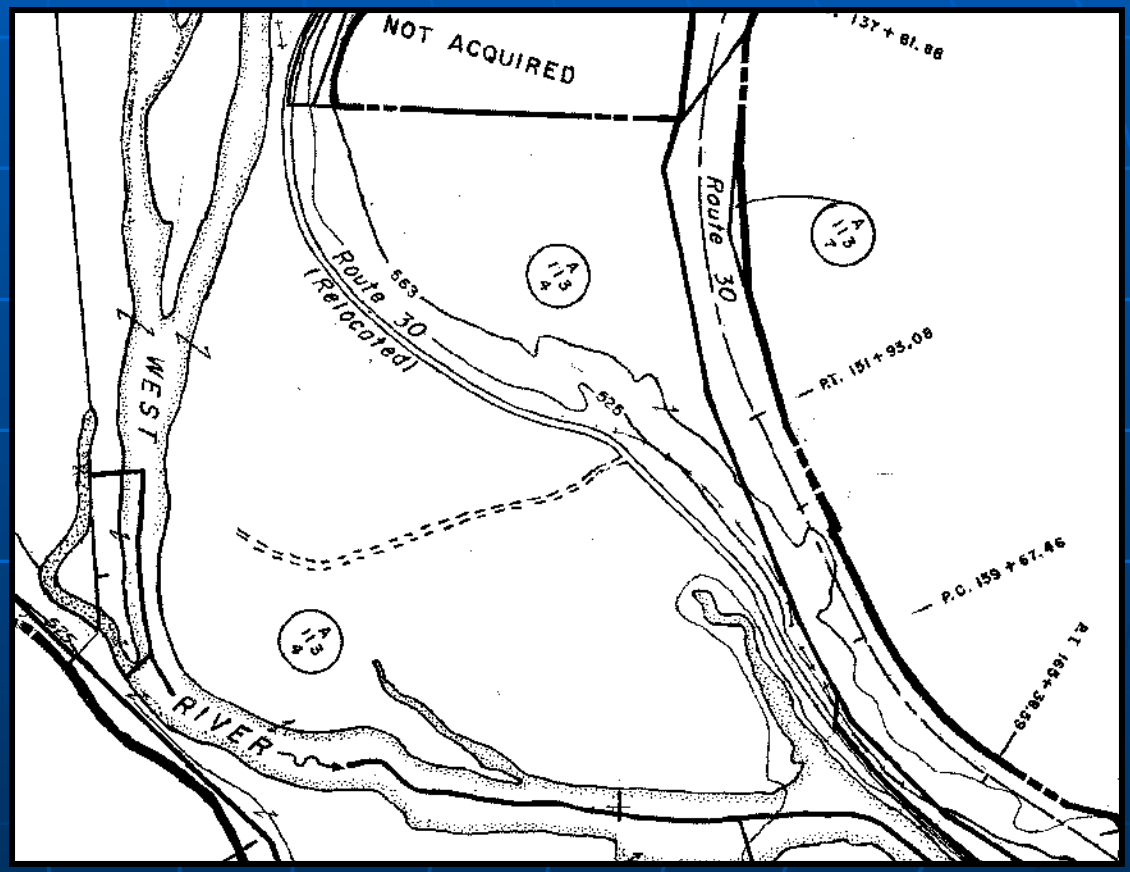
Coordinate Geometry

- Individual tracts or polygons must be edgematched
  - 200 tract maps or sheet
- Discrepancies mus
  be manually resol

US Army Corps of Engineers

Case Study: Rock Island District

- Illinois Waterway Pilot Project
  - COGO used to create GIS tract files for 8 pools
  - Used maps and legal descriptions
  - Approximately 360 tracts
  - Attributes for unique identification
  - Metadata
  - Project boundary inherent in cost



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of Engineers

Case Study: Rock Island District

Costs of Converting Existing Tracts to GIS Format for Eight Pools Along the Illinois Waterway, Rock Island District	
Pool	**Number of Mapped Tracts**
Brandon Road	19
Dresden	71
Marseilles	30
O'Brien	75
Peoria	17
Starved Rock	65
LaGrange	78
Peoria Boatyard	5
Total No. of Tracts	360
Total Cost	$84,500
Average Cost per Tract	$235

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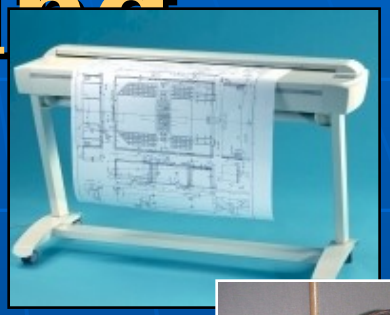
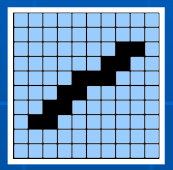
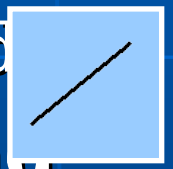
Scanning & Heads-up Digitizing





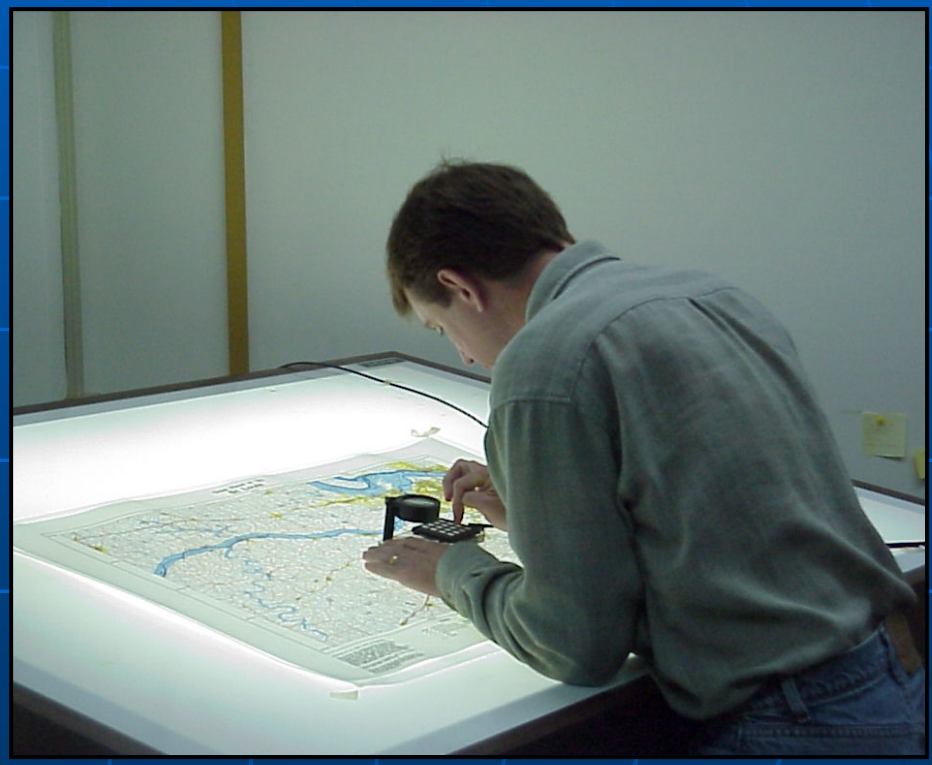


- Scanned maps
  - Raster format
  - Must be vectorized
- Heads-up digitizing
  - Display raster file and trace boun with screen cursor
    - Maps registered
    - Polygons must be built
    - Attributed (tract number and project id)
    - Individual maps mosaiced

US Army Corps of Engineers

Tablet Digitizing Hardcopy Maps

- Traditional tablet digitizing method
  - Must register map
  - Polygons must be built
  - Attributed (tract number and project id)
  - Individual maps mosaiced
  - Used to fill in the missing pieces for project boundary and tracts



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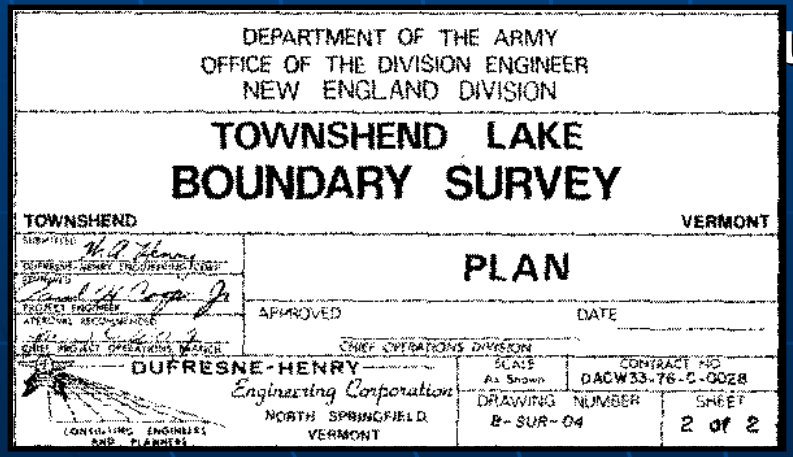
Fort Worth District
Lewisville Lake

- **Property boundary**
  - GPS technology used to locate project monuments
    - GPS used to cover over 200 mile project perimeter and 3,000 monuments
    - 1,700 usable monuments found
  - Other methods used to complete project boundary
    - COGO (used bearings and distances from maps to find location of missing monuments – bearings only to degrees and minutes)
    - Scanned and heads-up digitized segment maps
- **Tracts**
  - Scanned and heads-up digitized segment maps (total cost ~$48/tract)

US Army Corps of Engineers

New England District

- **Property boundary (31 flood control projects)**
  - Keyed in real world project monument coordinates from boundary survey sheets (connect the dots)
  - Scanned and heads-up digitized project boundary survey maps where property boundary did not connect from monument to monument (e.g. where it follows road or river)
- **Tracts**


DEPARTMENT OF THE ARMY
OFFICE OF THE DIVISION ENGINEER
NEW ENGLAND DIVISION

TOWNSHEND LAKE
BOUNDARY SURVEY

TOWNSHEND VERMONT

PLAN

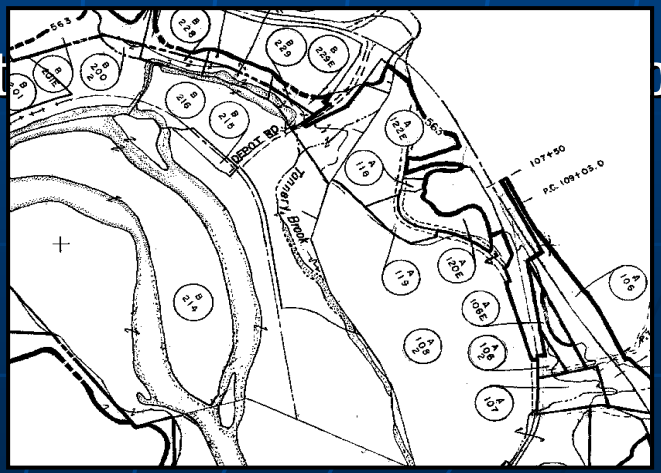
APPROVED DATE

CHIEF OPERATIONS DIVISION

DUFRESNE-HENRY Engineering Corporation
CONSULTING ENGINEERS AND PLANNERS
NORTH SPRINGFIELD VERMONT

SCALE As Shown
CONTRACT NO DACW33-76-C-0028
DRAWING NUMBER B-SUR-04
SHEET 2 of 2

up digit



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US Army Corps of Engineers

Walla Walla District

- **Property boundary** (Lower Snake River Projects, McNary, Dworshak)
  - Keyed in real world monument coordinates from boundary monument coordinate table (connect the dots)
  - Non-monumented boundary segment used bearing-distance call-outs and scanning and heads-up digitizing from boundary maps
- **Tracts**
  - Scanned and heads
    digitized segment
    (total cost ~ $49/t

RIGHT BANK (CONT.)			
DESCRIPTION	WASH. COORDINATES SOUTH		DISTANCE AND BEARING
	NORTHING	EASTING	
404=407	425,101.64	2,831,158.51	
407-4A	424,838.32	2,831,173.86	263.77' S03°20'50.2"E
407-4B	424,697.64	2,831,182.05	140.92' S03°20'50.2"E
407-4C	424,628.23	2,831,186.09	69.53' S03°20'50.2"E
407-4D	424,511.62	2,831,192.88	116.81' S03°20'50.2"E
407-4E	423,846.45	2,831,231.67	666.30' S03°20'50.2"E
			61.03' S03°20'50.2"E

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Cost to Convert Tract and Project Boundary

$11/tract **$48/tract** **$235/tract**

340,000 tracts

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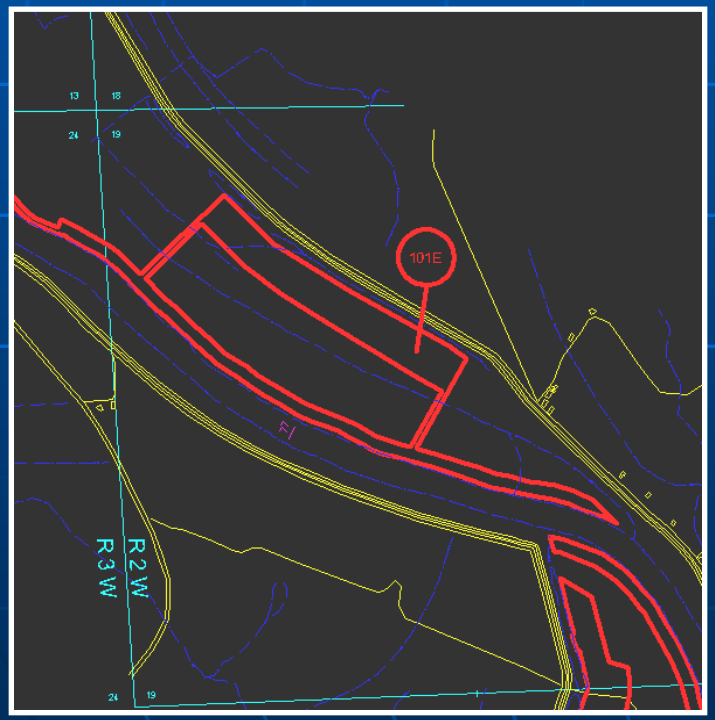
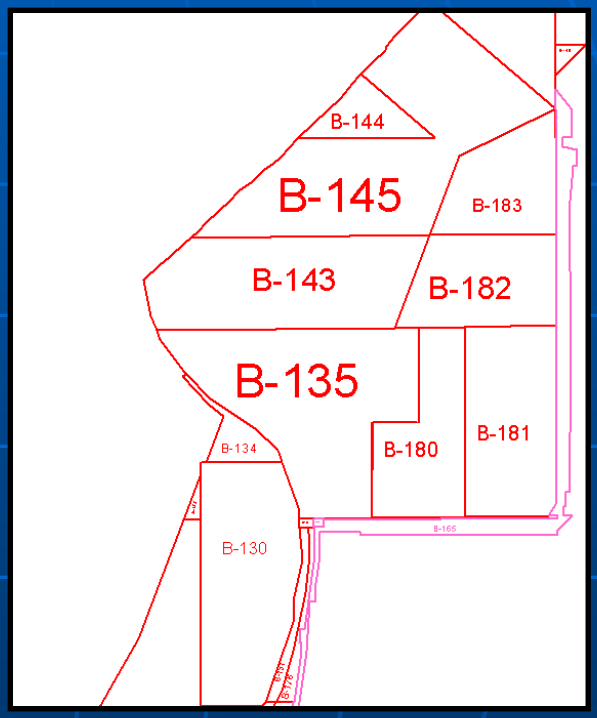
Existing Digital Data

- Real World coordinates or not
- Majority CAD files not topologically correct



Tracts are often line features with labels outside the tract polygon



Tracts need to be polygons with labels inside polygon

Annotation versus attributes

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Comparison

COGO	Scanning & Heads-up Digitizing or Automated Vectorization	Tablet Digitizing
▪ Real World Coordinates - Positional accuracy - Shape of tracts precise ▪ No real world coordinates - positional accuracy may be decreased	▪ Inaccuracies present in the original maps will be reproduced ▪ Falsely recognizing railroad, roads, water bodies, text boxes, as boundaries	▪ Accuracy limited by the stability of the source media and drafting quality of the source and digitizer ▪ Tedious and error-prone ▪ Clean-up or editing step

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Combination of Methods

- In reality – a combination of methods will be necessary

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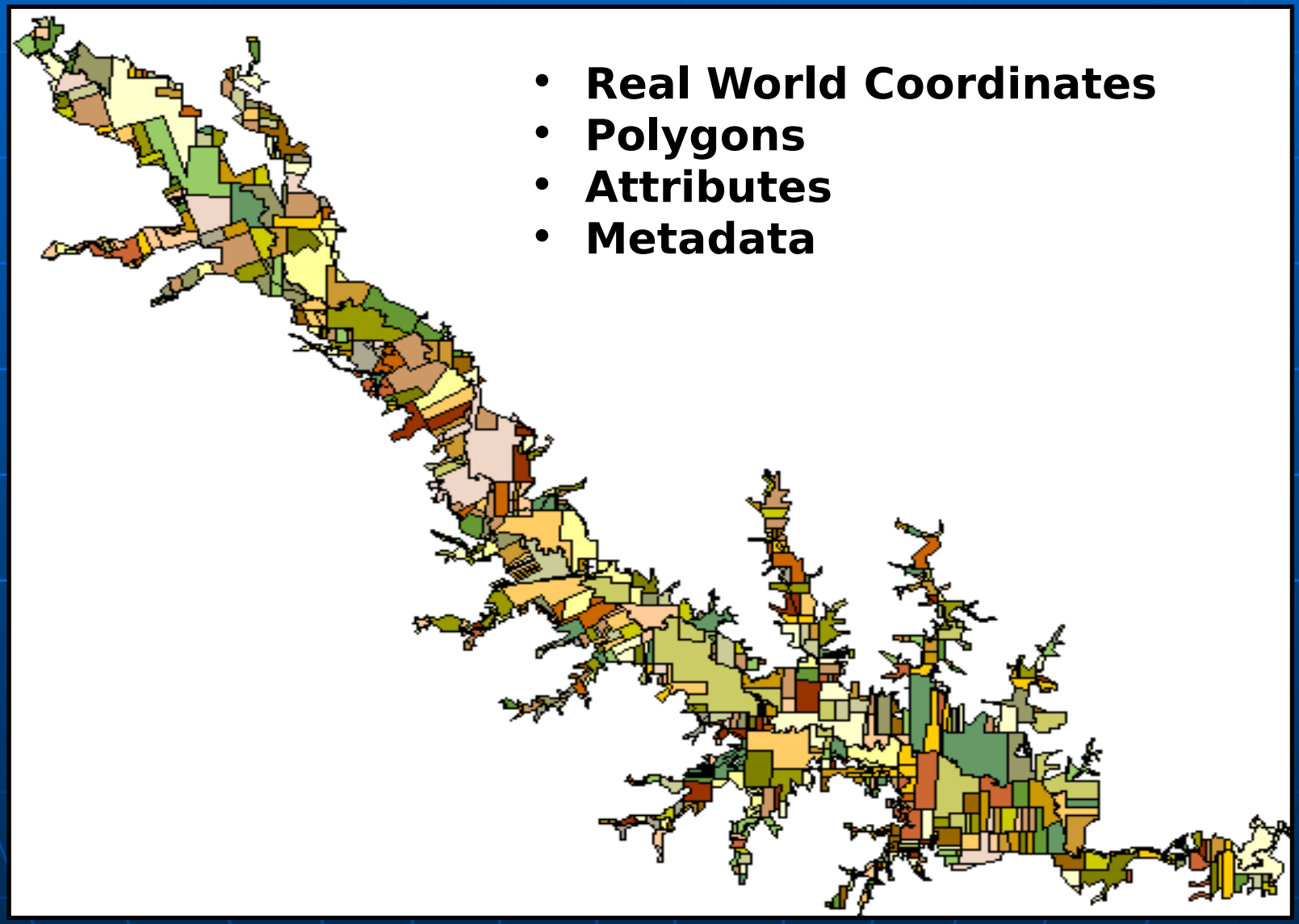
Tracts



- Real World Coordinates
- Polygons
- Attributes
- Metadata

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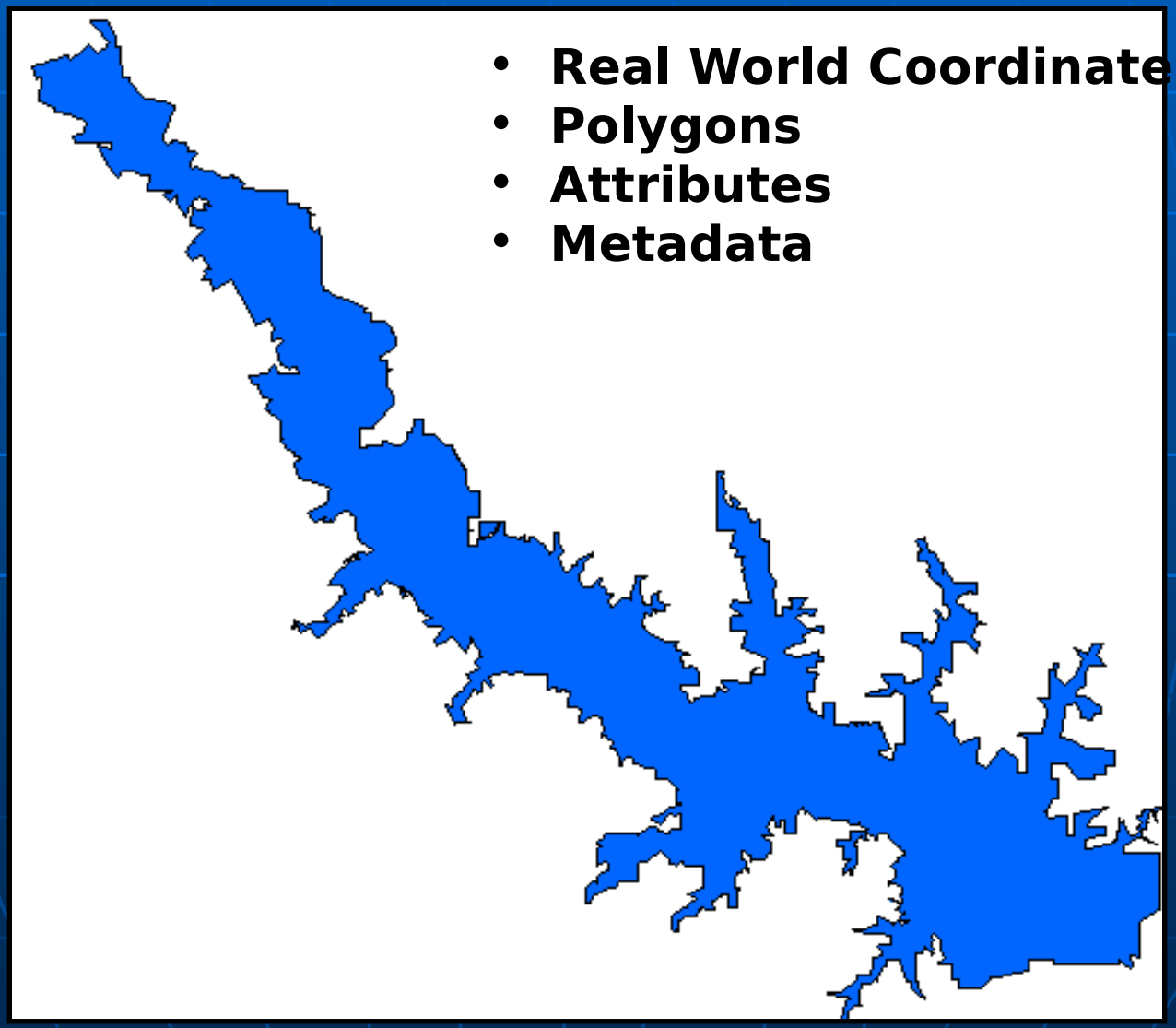
Project Boundary



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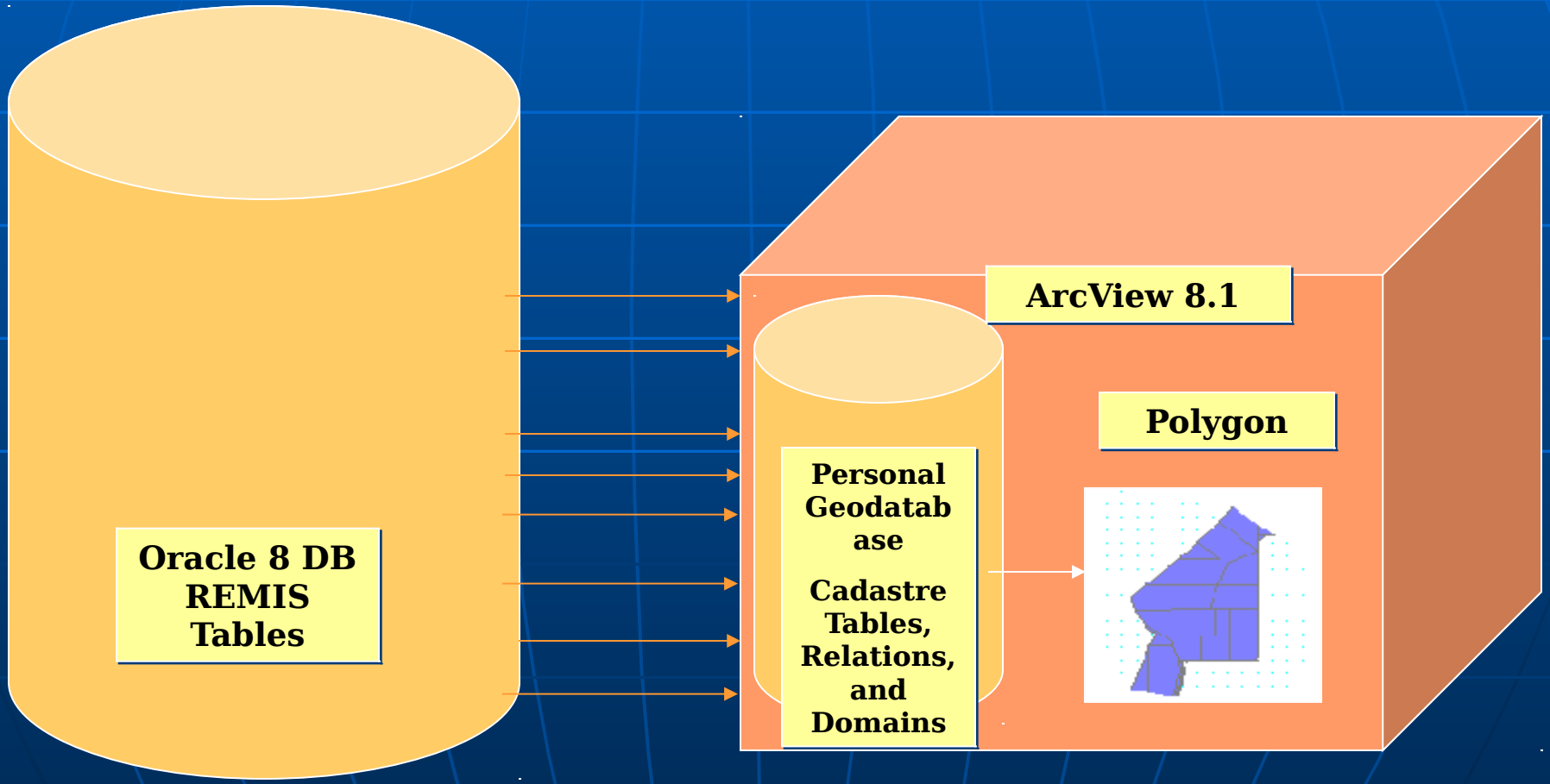
Linking Corporate GIS to REMIS



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Cadastre Real Estate Software Tool

- Developed in Visual Basic for ArcGIS 8.1
- Initial version had a geodatabase "generator" for cadastral feature dataset
- When SDS started including a generator this was removed from tool
  - Tool then got out of sync with SDS
    - DEED table modifications
- Has been used by 5 or 6 districts
  - Either ERDC-EL has attached REMIS attributes for the district
  - Or we provided code to districts with information on changes which need to be made

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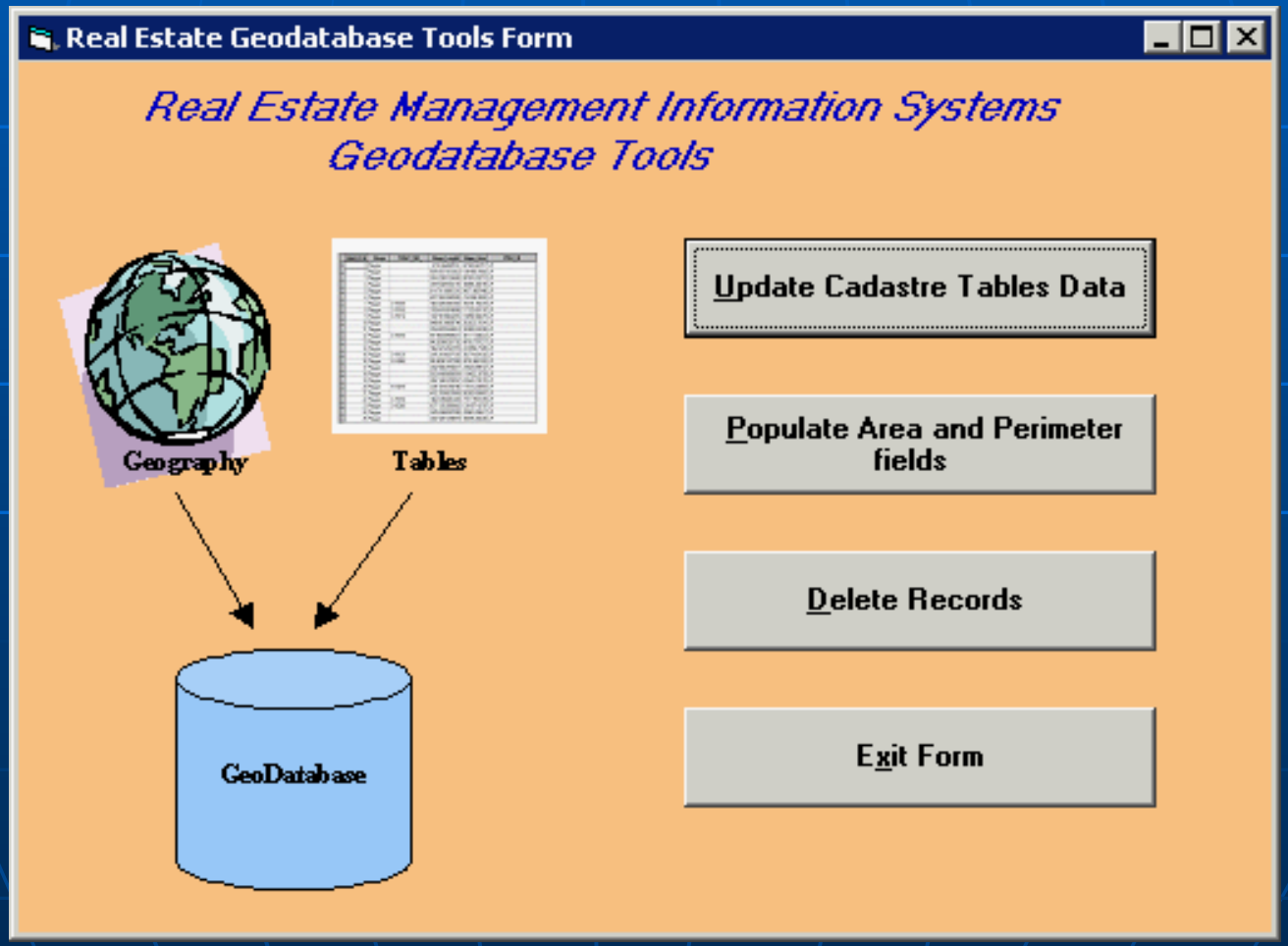
Cadastre Real Estate Software Tool



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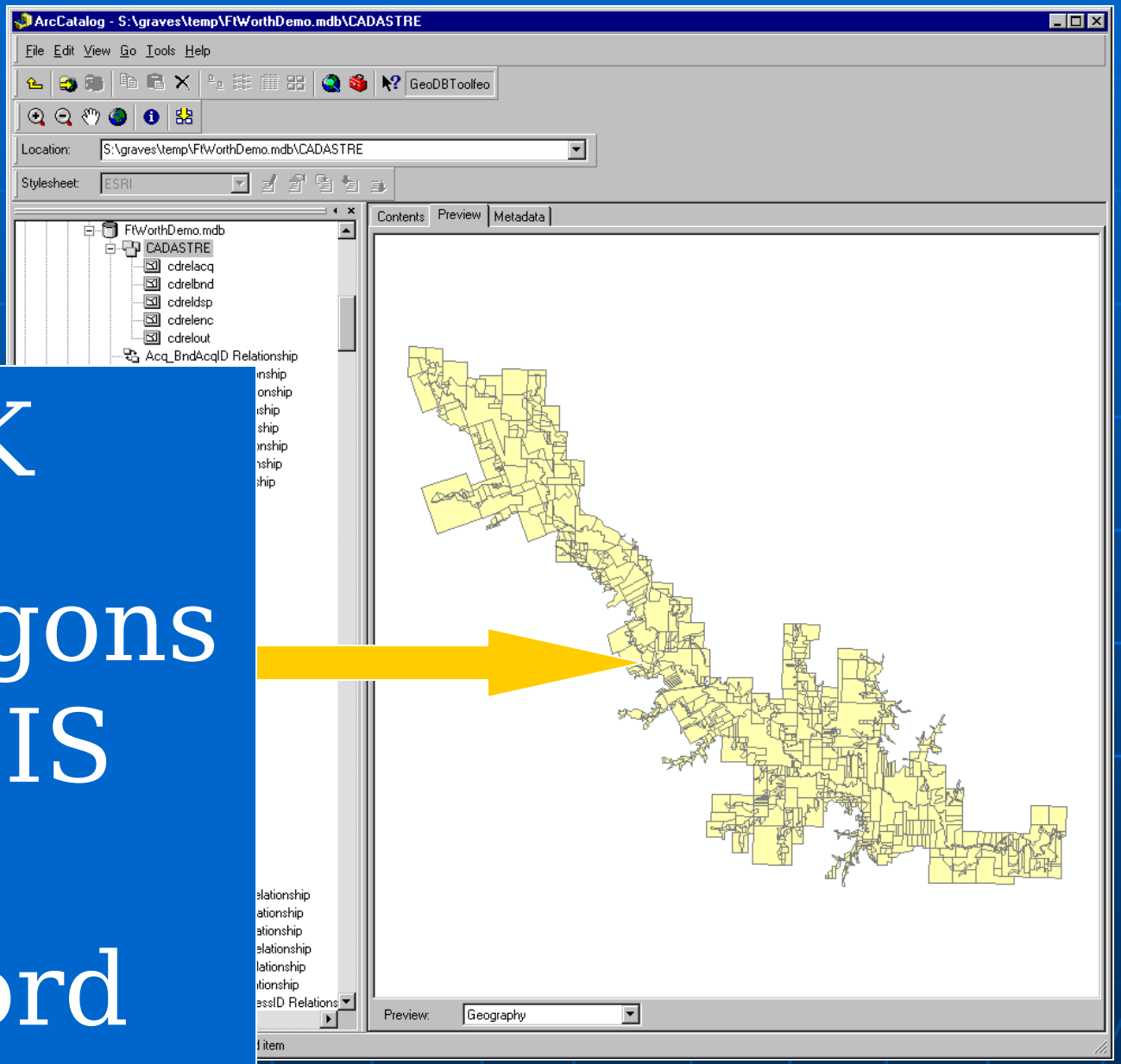

LINK Polygons in GIS to Record in RFMIS

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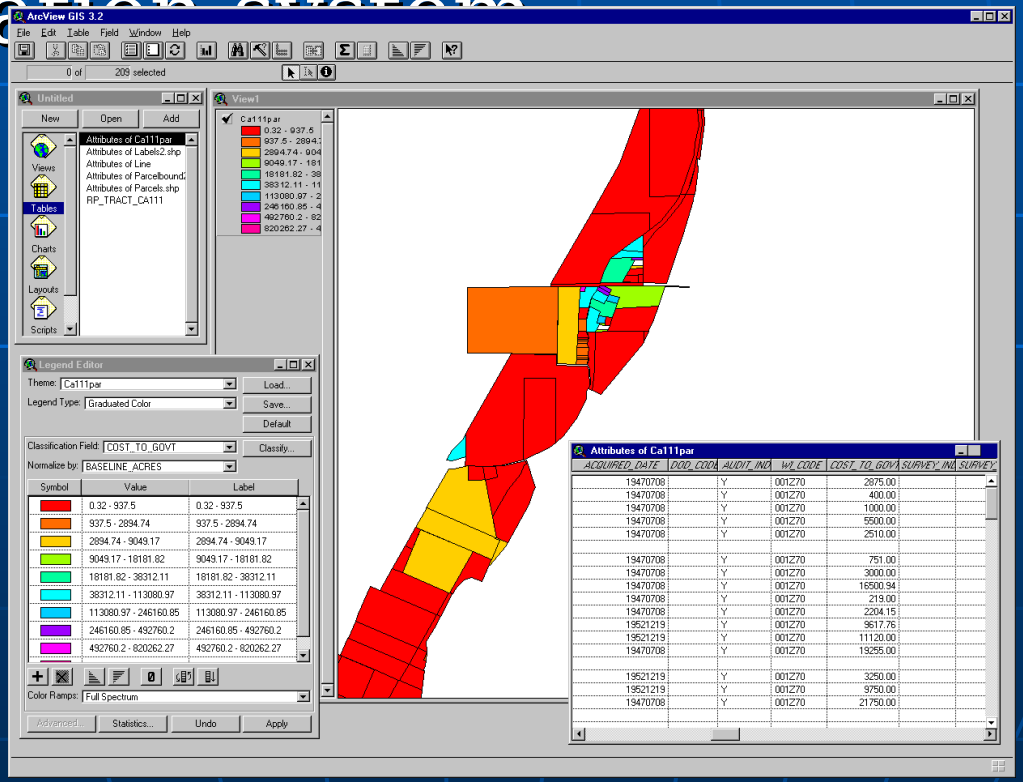
What Is a Link?

- A way for the features (tracts, roads, etc.) in your GIS to be connected to data in another information system



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What is Required for a Link

- In short: The same item(s) must exist in the GIS and in the legacy database table(s) you are linking to

GIS attributes

REMIS

Attributes of Ca111par

			Field1	Cadtext
7629.93068	2	4	b-153	B-153
3605.12423	3	3	b-152	B-152
1554.34068	4	2	b-151	B-151
9002.23181	5	6	b-150	B-150
9751.51919	6	5	b-147	B-147
1235.61795	7	0		
2100.85434	8	7	b-149	B-149
5148.80625	9	114	b-148	B-148
15381.93838	10	9	b-145	B-145
1433.95234	11	8	b-146	B-146
4625.17578	12	10	b-144	B-144
6321.74039	13	11	b-183	B-183
6836.82109	14	12	b-182	B-182
9838.78761	15	13	b-143	B-143
2831.76496	16	0		
7936.71300	17	16	b-181	B-181
8043.57895	18	15	b-180	B-180
11608.74396	19	14	b-135	B-135
632.03186	20	0		
0.04682	21	0		
0.03418	22	0		
4556.48351	23	17	b-134	B-134
2720.28612	24	0		
9108.51484	25	1	b-130	B-130
1592.98644	26	115	b-133	B-133

RP_TRACT_CA111

PROJ_ID	TRACT_NO	PARENT_TRACT_NO	CONTAM
CA111	B-144	PURCHASE-3122	
CA111	B-145	PURCHASE-3122	
CA111	B-146	PURCHASE-3122	
CA111	B-147	PURCHASE-3122	
CA111	B-148	PURCHASE-3122	
CA111	B-149	PURCHASE-3122	
CA111	B-150	PURCHASE-3122	
CA111	B-151	PURCHASE-3122	
CA111	B-152	PURCHASE-3122	
CA111	B-153	PURCHASE-3122	
CA111	B-165	PURCHASE-3122	
CA111	B-166	PURCHASE-3122	
CA111	B-167	PURCHASE-3122	
CA111	B-168	PURCHASE-3122	
CA111	B-169	PURCHASE-3122	
CA111	B-170	PURCHASE-3122	
CA111	B-172	PURCHASE-3122	
CA111	B-173	PURCHASE-3122	
CA111	B-174	PURCHASE-3122	
CA111	B-175	PURCHASE-3122	
CA111	B-176	PURCHASE-3122	
CA111	B-177	PURCHASE-3122	
CA111	B-178	PURCHASE-3122	
CA111	B-179	PURCHASE-3122	
CA111	B-180	PURCHASE-3122	

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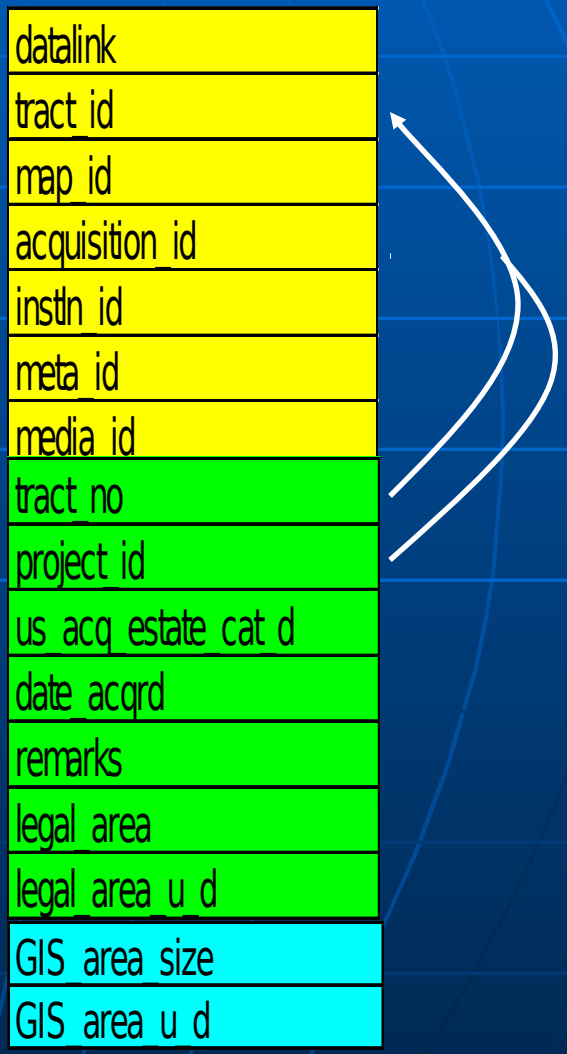
Building the Link to REMIS

- Two items were required in REMIS to reference individual tracts
  - Other items required for disposals, outgrants, etc.
- These items were concatenated to form the unique “tract_id” field in the SDS tables
  - So each tract_id in the SDS tables references a unique legal area



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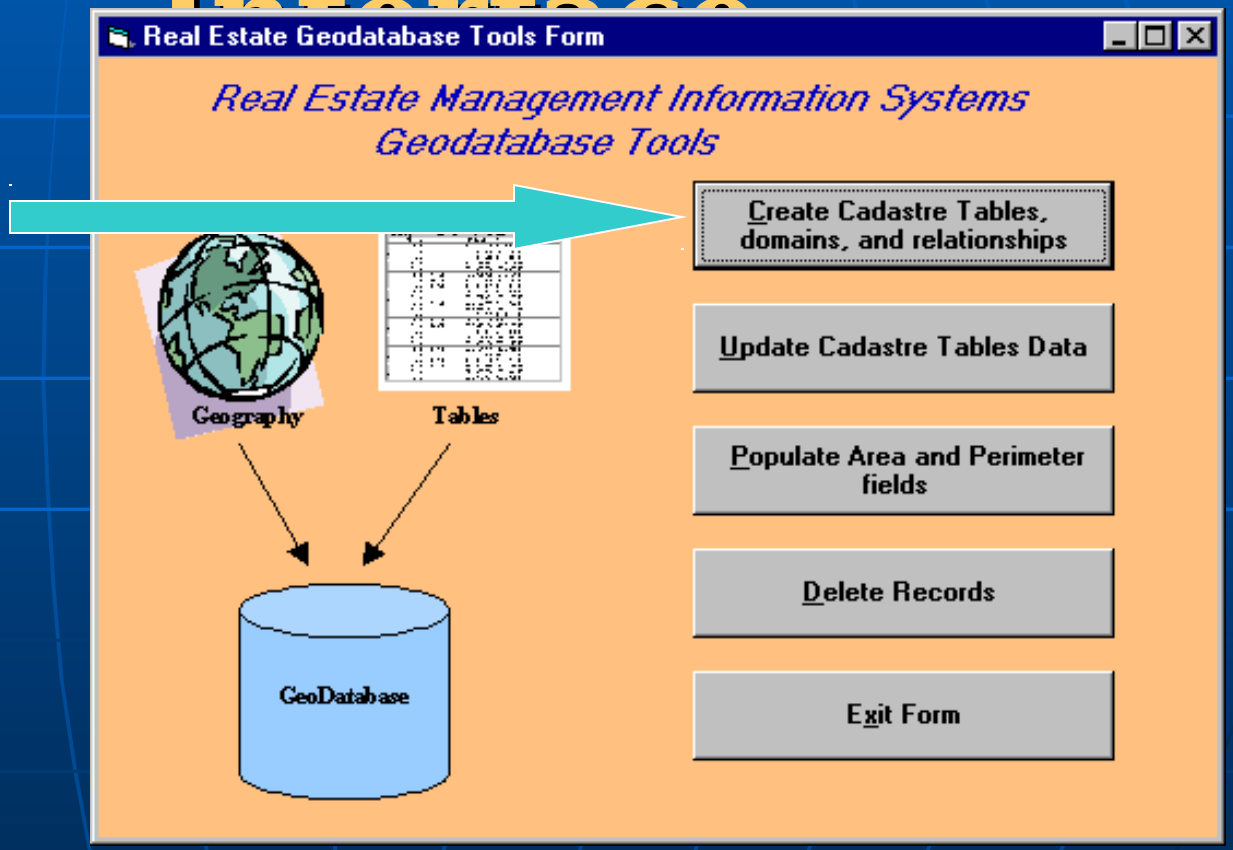
Cadastre Real Estate Software Tool Interface

Creates Empty SDS-Compliant Real Estate Geodatabase Data Structure



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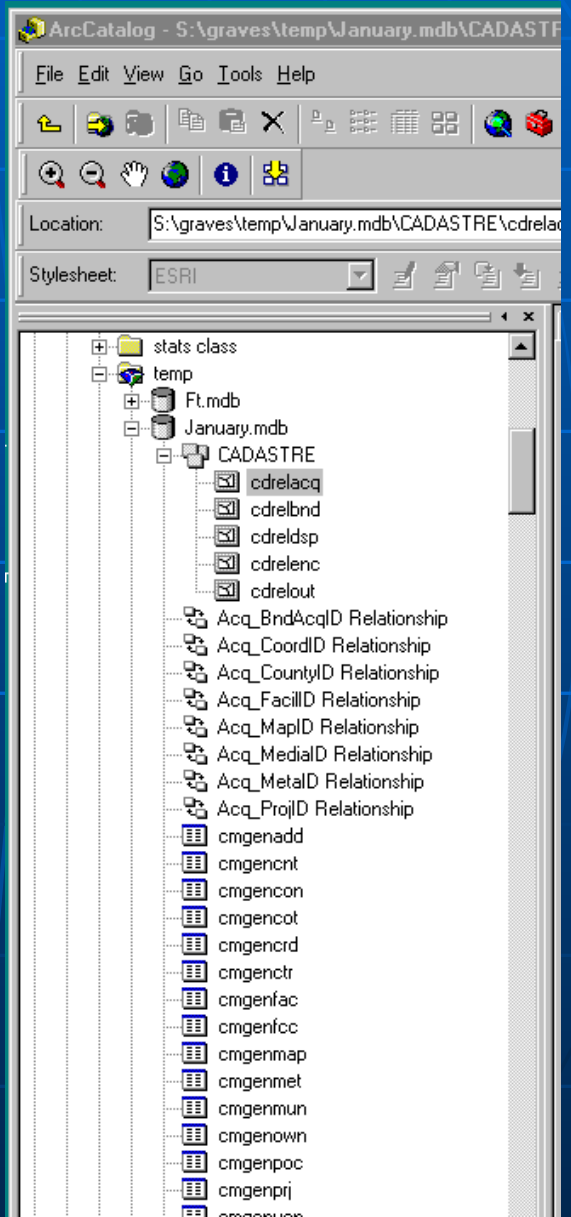
Empty Geodatabase

- Empty Structure Created
- Polygons Defining Tracts must be added
  - Digitized and in some other format
    - Such as ArcView shapefile



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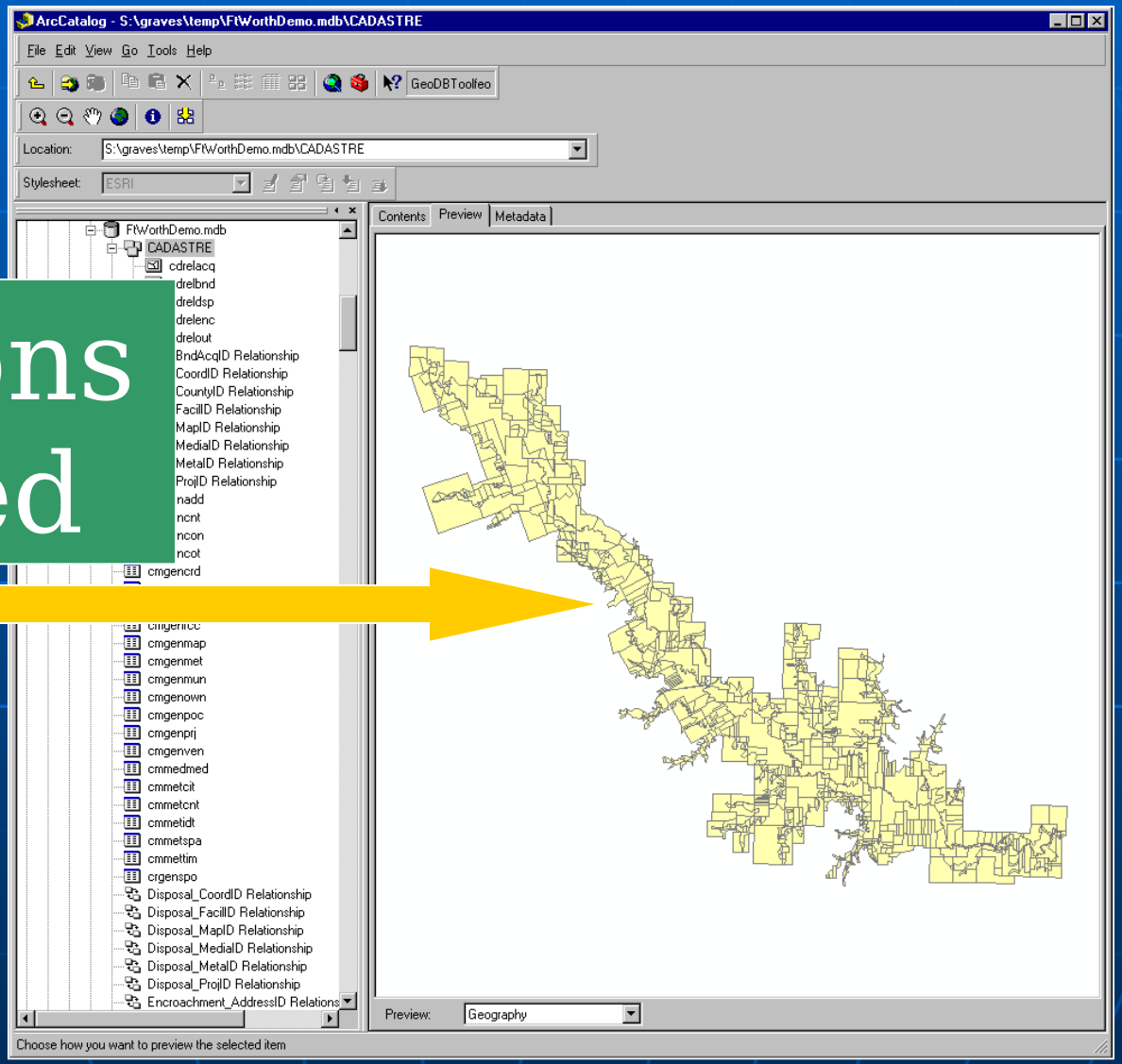
Polygons Loaded



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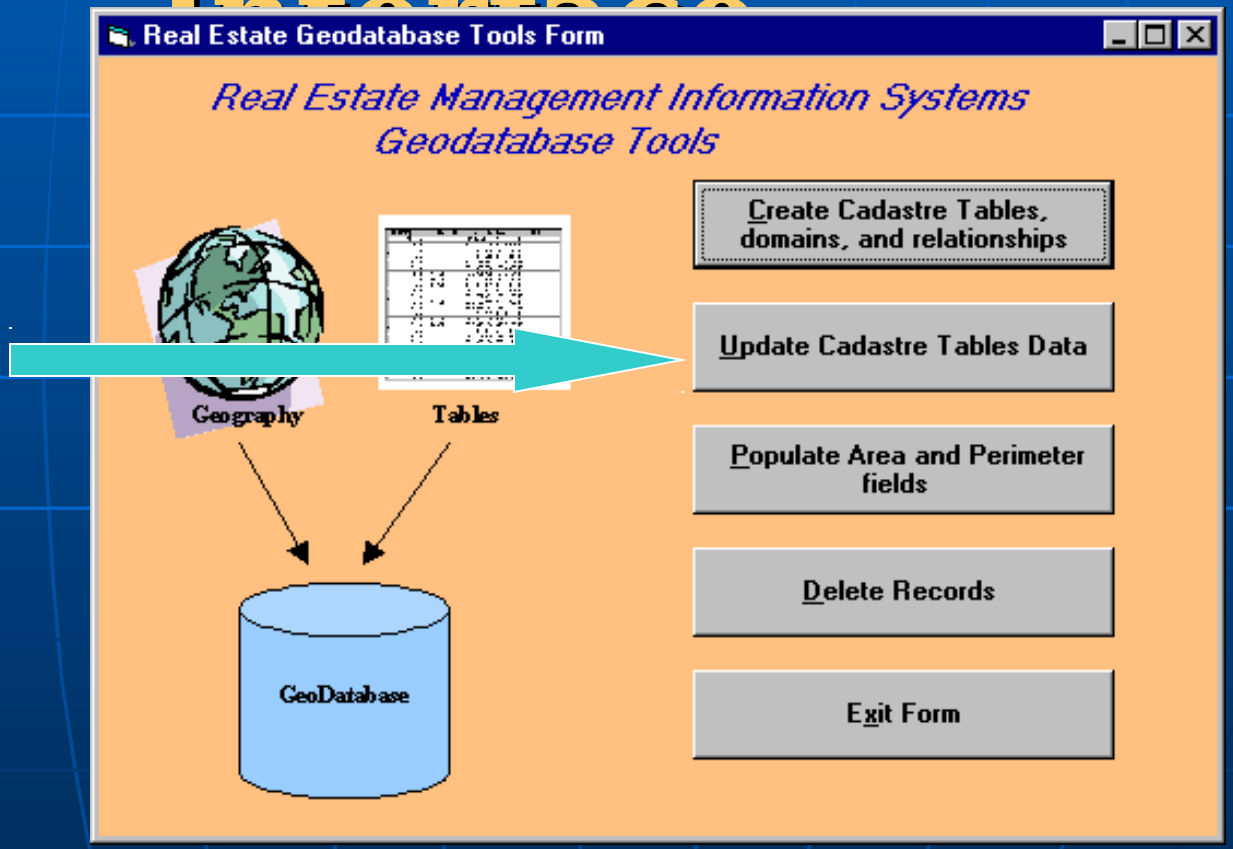
Cadastre Real Estate Software Tool Interface

Tie Information from REMIS to Polygons



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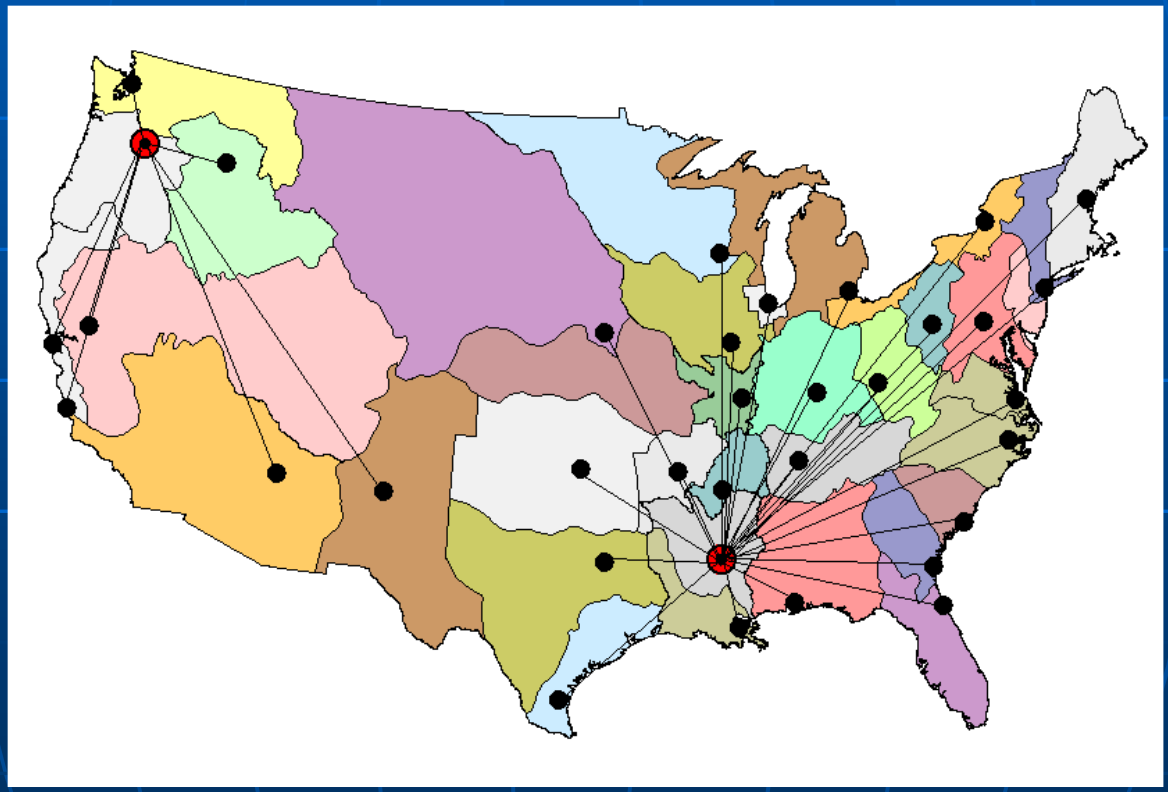
Physical Considerations

REMIS data resides at CPC



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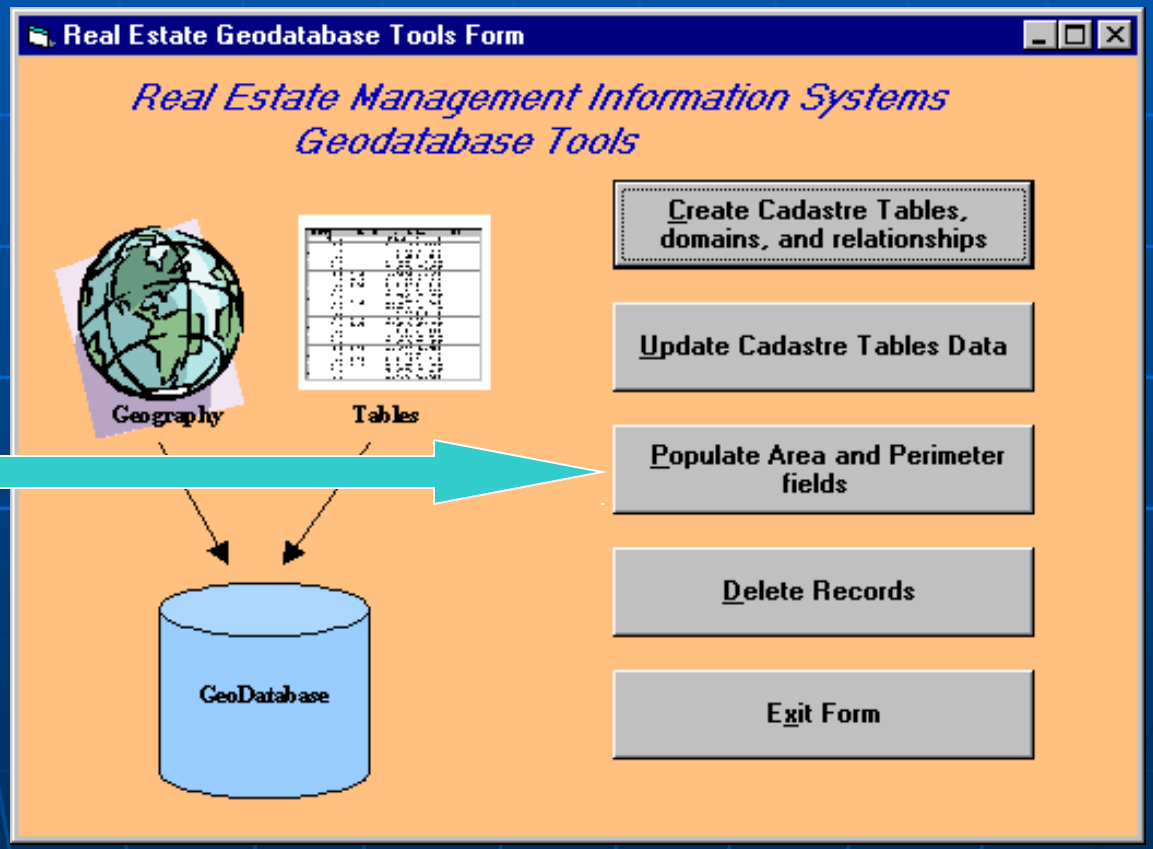
REMIS Tool Interface

Populates Area and Perimeter Fields from GIS Calculations



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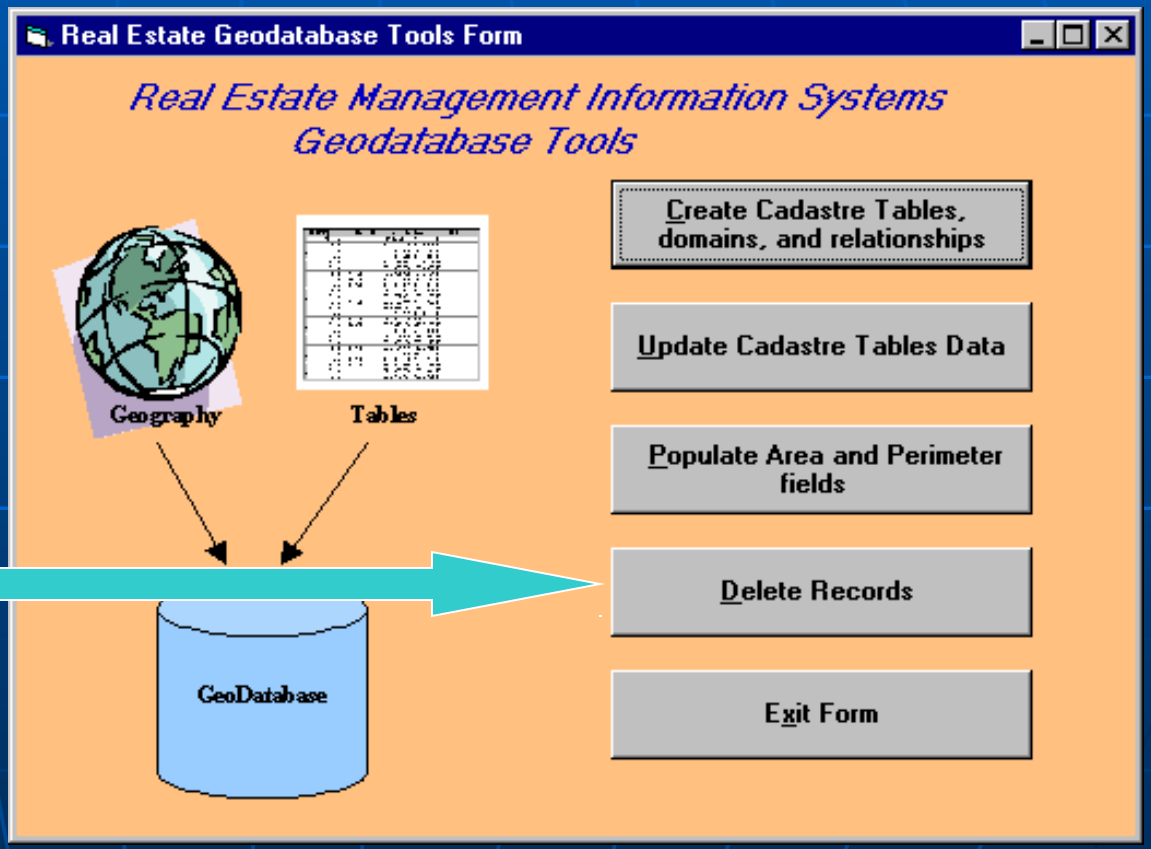
REMIS Tool Interface

Checks for Deleted Records in REMIS and Deletes Shapes



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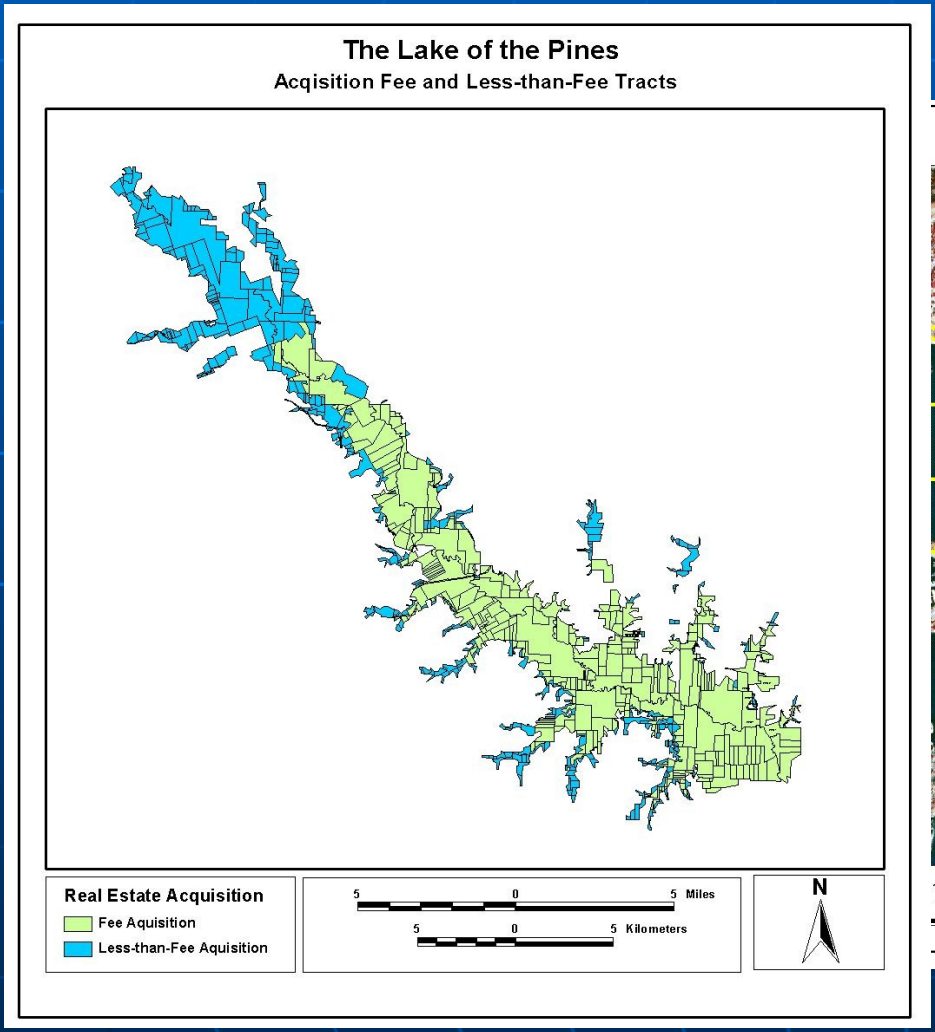
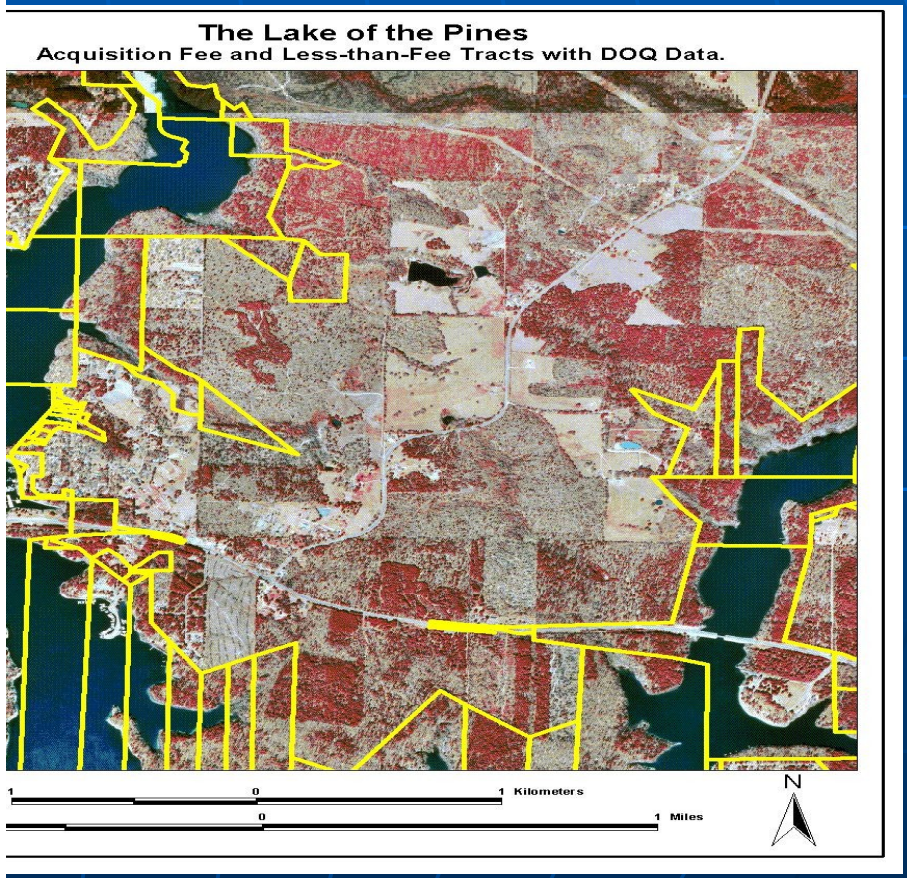
Implemented at Prototype Site





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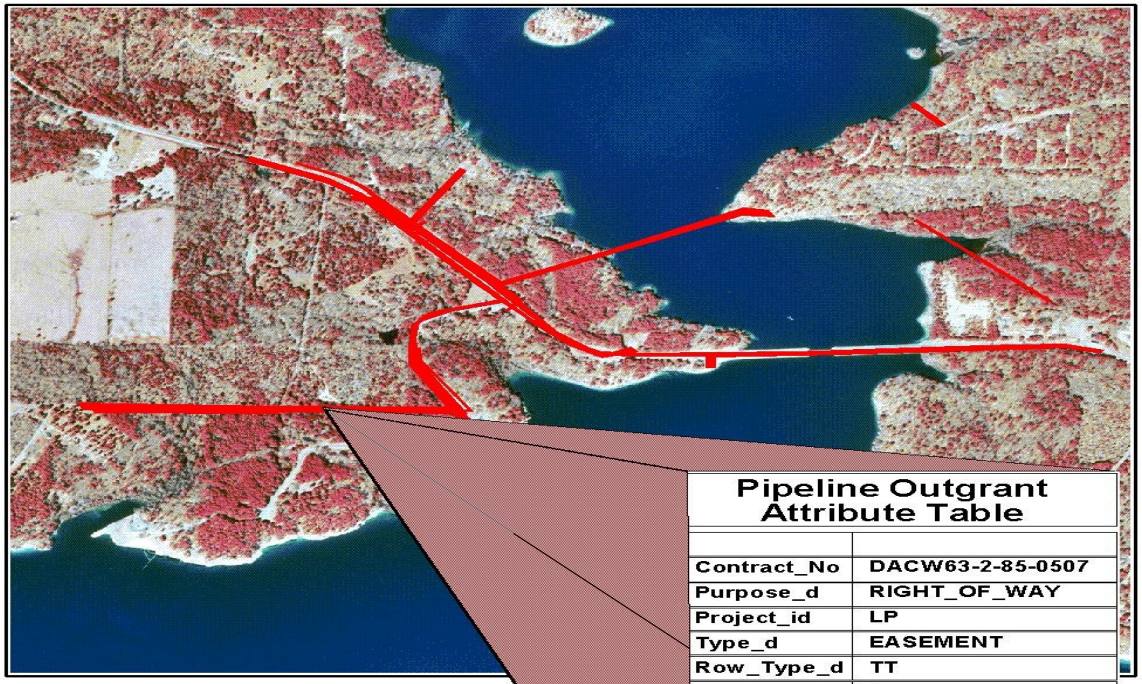
The Lake of the Pines

Real Estate Outgrants



Pipeline Outgrant Attribute Table

Contract_No	DACW63-2-85-0507
Purpose_d	RIGHT_OF_WAY
Project_id	LP
Type_d	EASEMENT
Row_Type_d	TT
Status	A.
Effect_Date	19841012
Expir_Date	20341011
Schin_Date	19970812
Actin_Date	0
Lstin_Date	19970812
Comp_Ind_d	Y
Inspector	
Grantee_No	A4PMO3
Grnte_Name	ETEX TELEPHONE

0.25 0 0.25 0.5 Miles

0.25 0 0.25 0.5 Kilometers

N

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The Lake of the Pines

Proposed Real Estate Outgrant

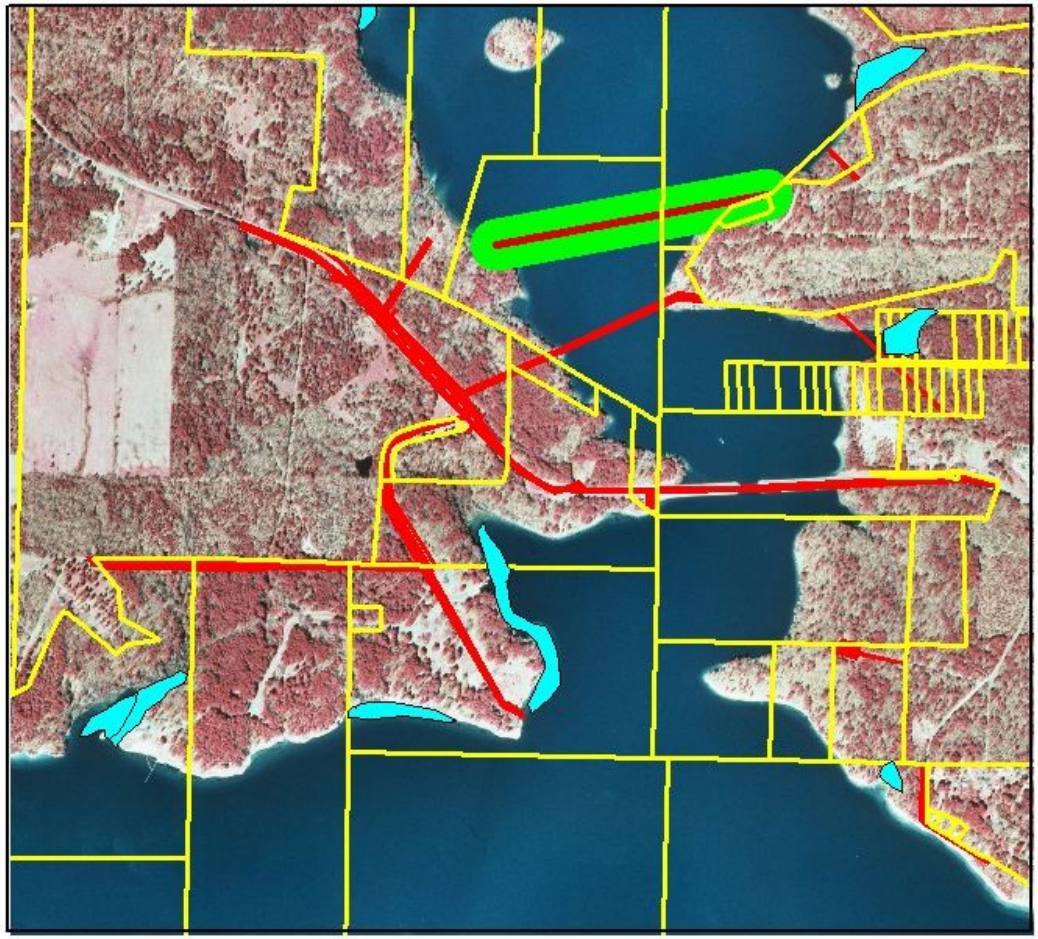

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Figure 1. "As Is" Easement Business Process

Thursday, September 12, 2002

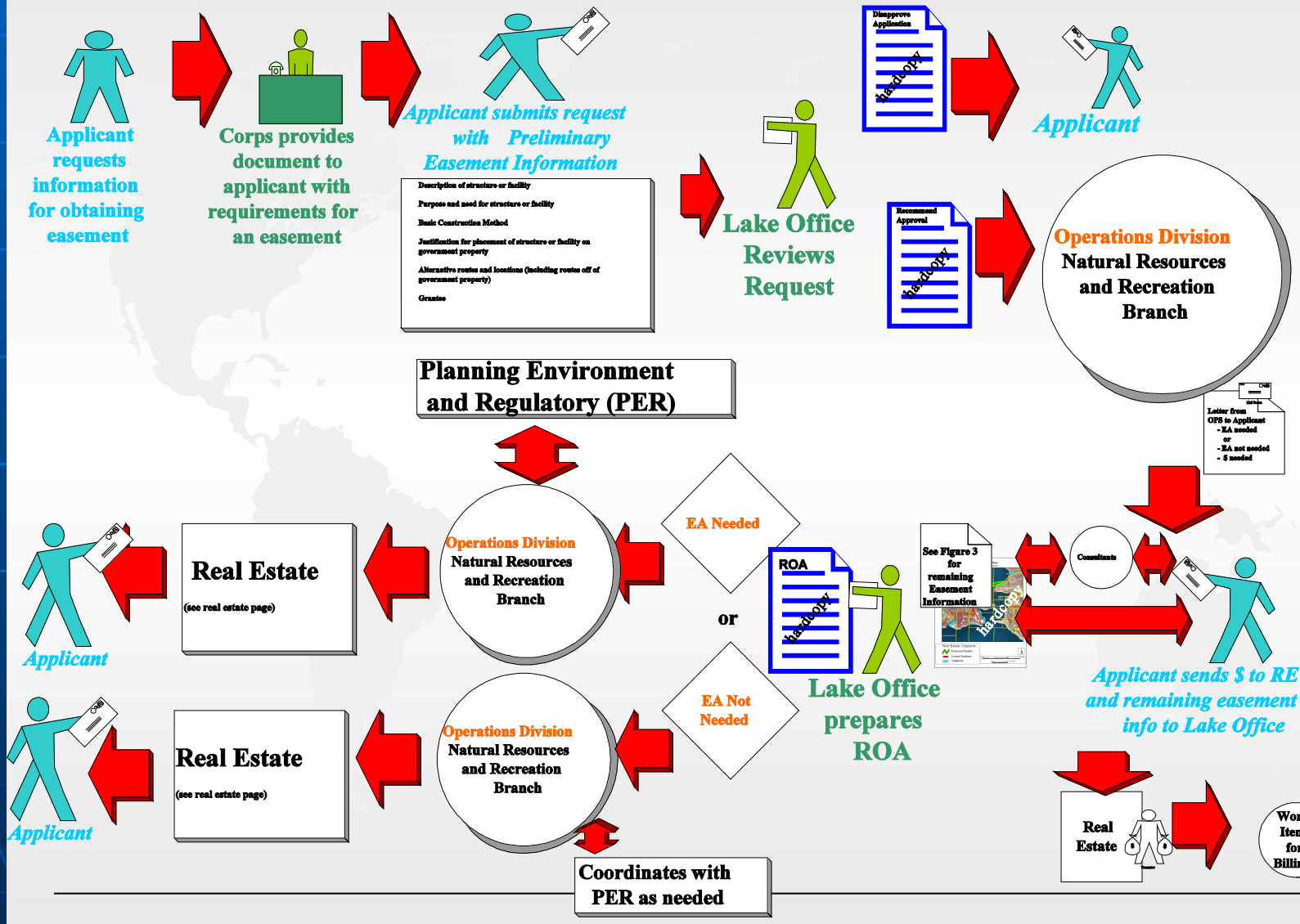
Applicant requests information for obtaining easement
Corps provides document to applicant with requirements for an easement
Applicant submits request with Preliminary Easement Information
Description of structure or facility
Purpose and need for structure or facility
Basic Construction Method
Justification for placement of structure or facility on government property
Alternative routes and locations (including routes off of government property)
Grantee
Lake Office Reviews Request
Disapprove Application
hardcopy
Applicant
Recommend Approval
hardcopy
Operations Division Natural Resources and Recreation Branch
Planning Environment and Regulatory (PER)
Letter from OPS to Applicant
- EA needed
or
- EA not needed
- $ needed
EA Needed
or
EA Not Needed
Operations Division Natural Resources and Recreation Branch
Real Estate
(see real estate page)
Applicant
Operations Division Natural Resources and Recreation Branch
Real Estate
(see real estate page)
Applicant
ROA
hardcopy
Lake Office prepares ROA
See Figure 3 for remaining Easement Information
hardcopy
Consultants
Applicant sends $ to RE and remaining easement info to Lake Office
Real Estate
Work Item for Billing
Coordinates with PER as needed

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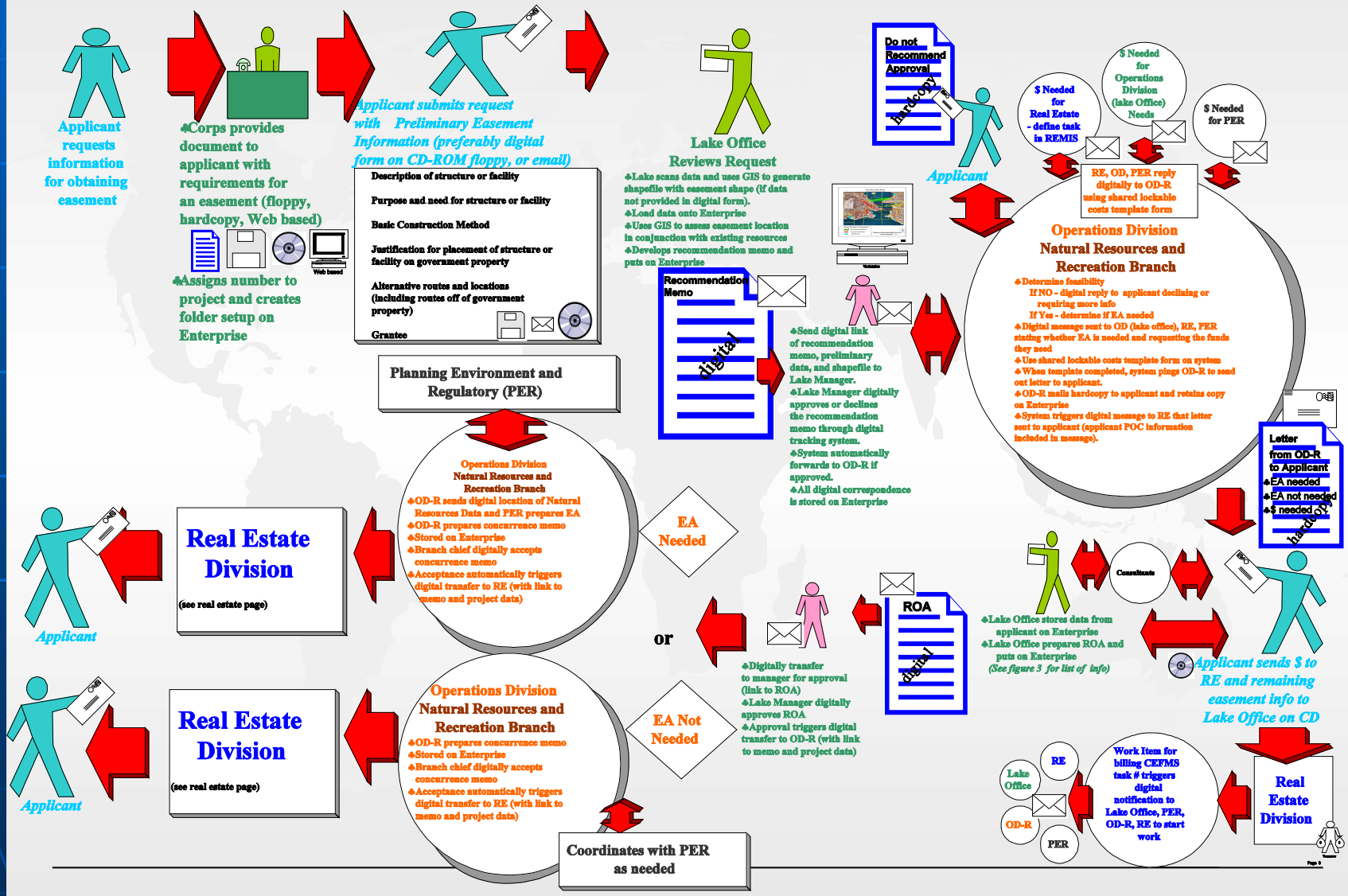
Figure 4. "To Be" Easement Business Process

Thursday, September 12, 2002


Applicant requests information for obtaining easement
Corps provides document to applicant with requirements for an easement (floppy, hardcopy, Web based)
Assigns number to project and creates folder setup on Enterprise
Applicant submits request with Preliminary Easement Information (preferably digital form on CD-ROM floppy, or email)
Description of structure or facility
Purpose and need for structure or facility
Basic Construction Method
Justification for placement of structure or facility on government property
Alternative routes and locations (including routes off of government property)
Grantee
Planning Environment and Regulatory (PER)
Lake Office Reviews Request
Lake scans data and uses GIS to generate shapefile with easement shape (if data not provided in digital form).
Load data onto Enterprise
Uses GIS to assess easement location in conjunction with existing resources
Develops recommendation memo and puts on Enterprise
Recommendation Memo
digital
Send digital link of recommendation memo, preliminary data, and shapefile to Lake Manager.
Lake Manager digitally approves or declines the recommendation memo through digital tracking system.
System automatically forwards to OD-R if approved.
All digital correspondence is stored on Enterprise
Do not Recommend Approval
hardcopy
Applicant
$ Needed for Real Estate - define task in REMIS
$ Needed for Operations Division (lake Office) Needs
$ Needed for PER
RE, OD, PER reply digitally to OD-R using shared lockable costs template form
Operations Division Natural Resources and Recreation Branch
Determine feasibility
If NO - digital reply to applicant declining or requiring more info
If Yes - determine if EA needed
Digital message sent to OD (lake office), RE, PER stating whether EA is needed and requesting the funds they need
Use shared lockable costs template form on system
When template completed, system pings OD-R to send out letter to applicant.
OD-R mails hardcopy to applicant and retains copy on Enterprise
System triggers digital message to RE that letter sent to applicant (applicant POC information included in message).
Letter from OD-R to Applicant
EA needed
EA not needed
$ needed
hardcopy
Consultants
Lake Office stores data from applicant on Enterprise
Lake Office prepares ROA and puts on Enterprise
(See figure 3 for list of info)
Applicant sends $ to RE and remaining easement info to Lake Office on CD
Real Estate Division
Work Item for billing CEFMS task # triggers digital notification to Lake Office, PER, OD-R, RE to start work
Lake Office
RE
OD-R
PER
EA Needed
Operations Division Natural Resources and Recreation Branch
OD-R sends digital location of Natural Resources Data and PER prepares EA
OD-R prepares concurrence memo
Stored on Enterprise
Branch chief digitally accepts concurrence memo
Acceptance automatically triggers digital transfer to RE (with link to memo and project data)
Real Estate Division
(see real estate page)
Applicant
or
ROA
digital
Digitally transfer to manager for approval (link to ROA)
Lake Manager digitally approves ROA
Approval triggers digital transfer to OD-R (with link to memo and project data)
EA Not Needed
Operations Division Natural Resources and Recreation Branch
OD-R prepares concurrence memo
Stored on Enterprise
Branch chief digitally accepts concurrence memo
Acceptance automatically triggers digital transfer to RE (with link to memo and project data)
Real Estate Division
(see real estate page)
Applicant
Coordinates with PER as needed

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Products Website

http://el.erdc.usace.army.mil/gdaf/realestate/realestate.html

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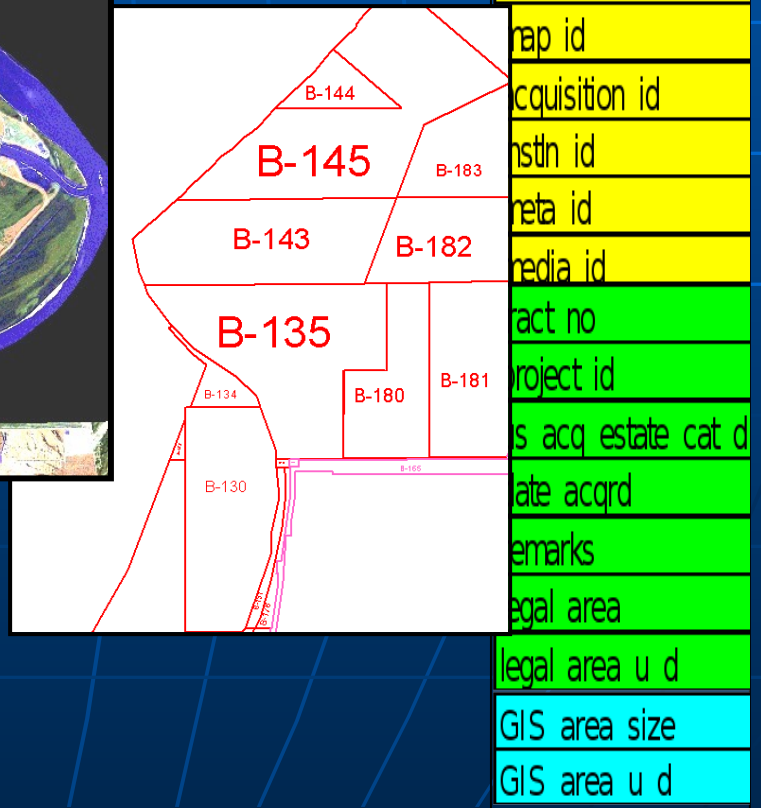
Real Estate Data & GIS



Linda Peyman Dove, ERDC-EL

Mark Gonyo, ERDC-EL

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Figure 2. "As Is" Easement Business Process for Real Estate Division

Thursday, September 12, 2002

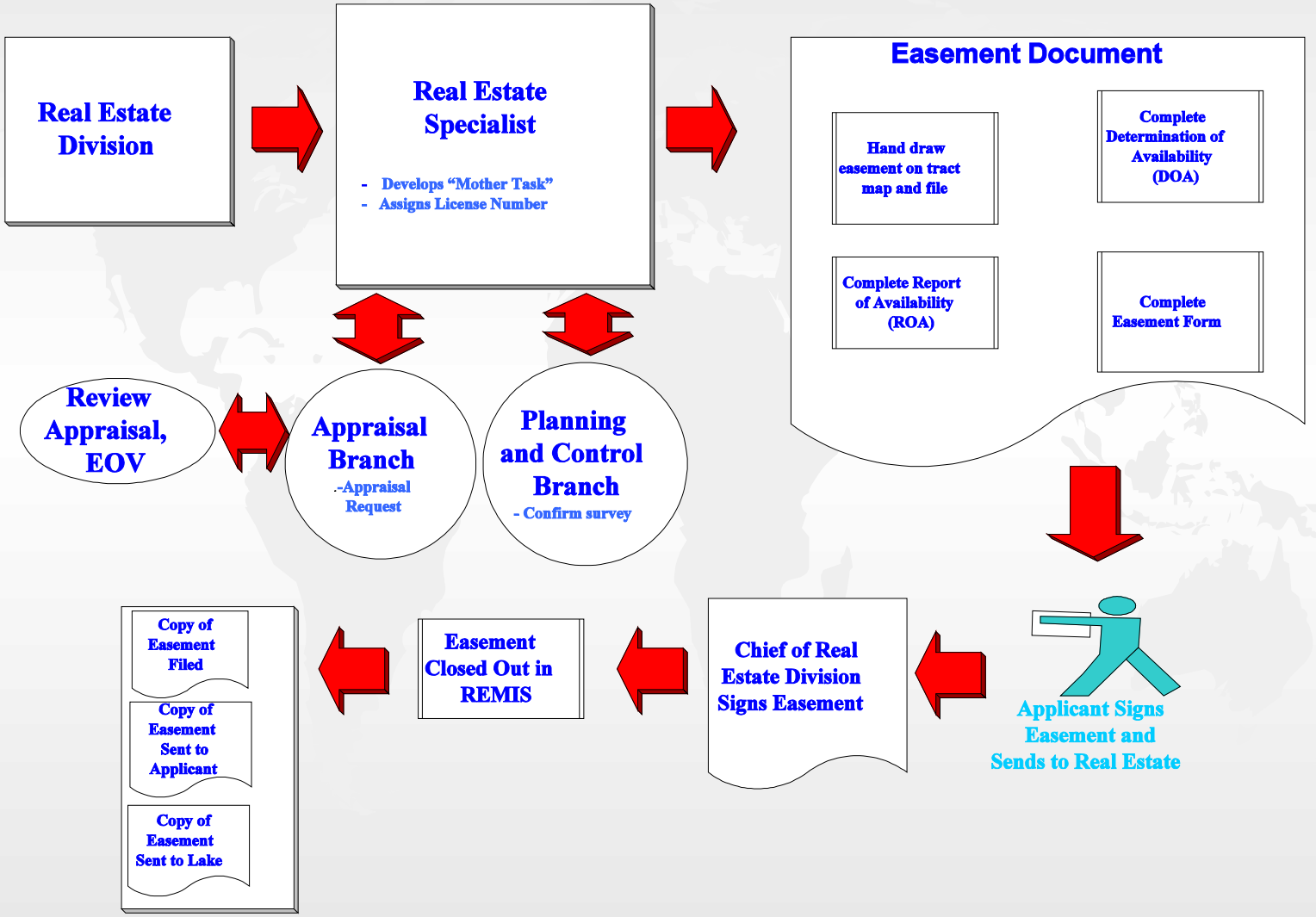
Real Estate Division
Real Estate Specialist
- Develops "Mother Task"
- Assigns License Number
Easement Document
Hand draw easement on tract map and file
Complete Determination of Availability (DOA)
Complete Report of Availability (ROA)
Complete Easement Form
Review Appraisal, EOV
Appraisal Branch
-Appraisal Request
Planning and Control Branch
- Confirm survey
Applicant Signs Easement and Sends to Real Estate
Chief of Real Estate Division Signs Easement
Easement Closed Out in REMIS
Copy of Easement Filed
Copy of Easement Sent to Applicant
Copy of Easement Sent to Lake

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Figure 3. Information Provided by Applicant for Easement

THURSDAY, SEPTEMBER 12, 2002

Applicant submits remaining information to Lake Office

General Easement

- Certification that structure/facility will be constructed, operated, and maintained in compliance with all Federal, State, and local laws and regulations
- Concurrence from third parties that may be affected by the structure/facility
- Concurrence from other agencies regarding legal or regulatory requirements where necessary (e.g. Texas Natural Resources Conservation Commission)

Project Description

General Description of Structure/Facility
Basic Construction Methods

Physical Description of Proposed Easement
Length & width
Construction area

Boundary Description of Easement
Narrative metes and bounds description
Acreage of proposed easement

Map of Proposed Easement
Location of easement
Metes and bounds depiction
must tie into known COE property monument
Depiction of COE property line adjacent to proposed easement
Upper guide contours and elevation intervals appropriate to terrain
COE structures affected
fences, roads, monuments, gates, intake structures, natural and environmental resources, etc.
Profile of all affected government property

Restricted Areas Affected by Easement
Portions of project affecting restricted areas around COE primary facilities (e.g. drilling or blasting near the dam and spillway)

Tract Maps where Easement Located
Fee or less-than-fee tracts

Natural Resources

- Wildlife Habitat Analysis
- Tree Inventory
- Endangered Species
- Cultural Resources
- Storm Water Requirements
- Hazardous Materials
- Mitigation Plans

Wetlands and Section 404 Information
Vicinity Map (location of project on county map, USGS quad sheet, etc. with borrow, disposal sites, or other outlying features
Delineation and description of wetlands and other waters of the US in area affected by proposed work
TR Y-87-1
Project purpose and need
Plan, profile, and cross-section views of temporary and permanent work in or adjacent to wetlands and waters of the US
Type, source, and volume of material proposed to be discharged into and/or excavated from wetlands and waters of US. Where activity may result in a change to pre-construction contours or drainage patterns, explain why changes are necessary and describe anticipated outcome
Width and depth of water body and waterward distance of any structures from existing shoreline if located on a navigable water or a USACE lake project.
Description of temporary and permanent impact on aquatic environment
Project schedule
Statement disclosing whether the proposed project will jeopardize the continued existence of any federally or state listed threatened or endangered species or destroy or adversely modify their critical habitat
Other relevant information, e.g. information on cultural resources and hydrology

Flood Storage Calculations

Requirement for Specific Structures

Electric Power and Communication Lines Structures and Facilities for Radio, TV, and other Communication Services
Line heights, voltage, cutoff locations and elevations (plans must be certified by an engineer as being in compliance with the National Electric Safety Code requirements, EB-1110-4401, 30 May 97 and the National Electric Code

Water Intake Structure
Written documentation showing permission has been procured from the water purveyor

Sewer Line
Plans must be certified by engineer as being in compliance with SWFOM 1165-2-3 and TNRCC regulations

Fuel Carrying Pipelines
Disclosure of ownership
Name and address of each partner
Name and address of each shareholder owning 3 % or more of the shares
Number and % of any class of voting shares of the entity
Name and address of each officials of the entity
Technical and financial capability

Major Water Lines
Plans must be certified by engineer as being in compliance with TNRCC regulations

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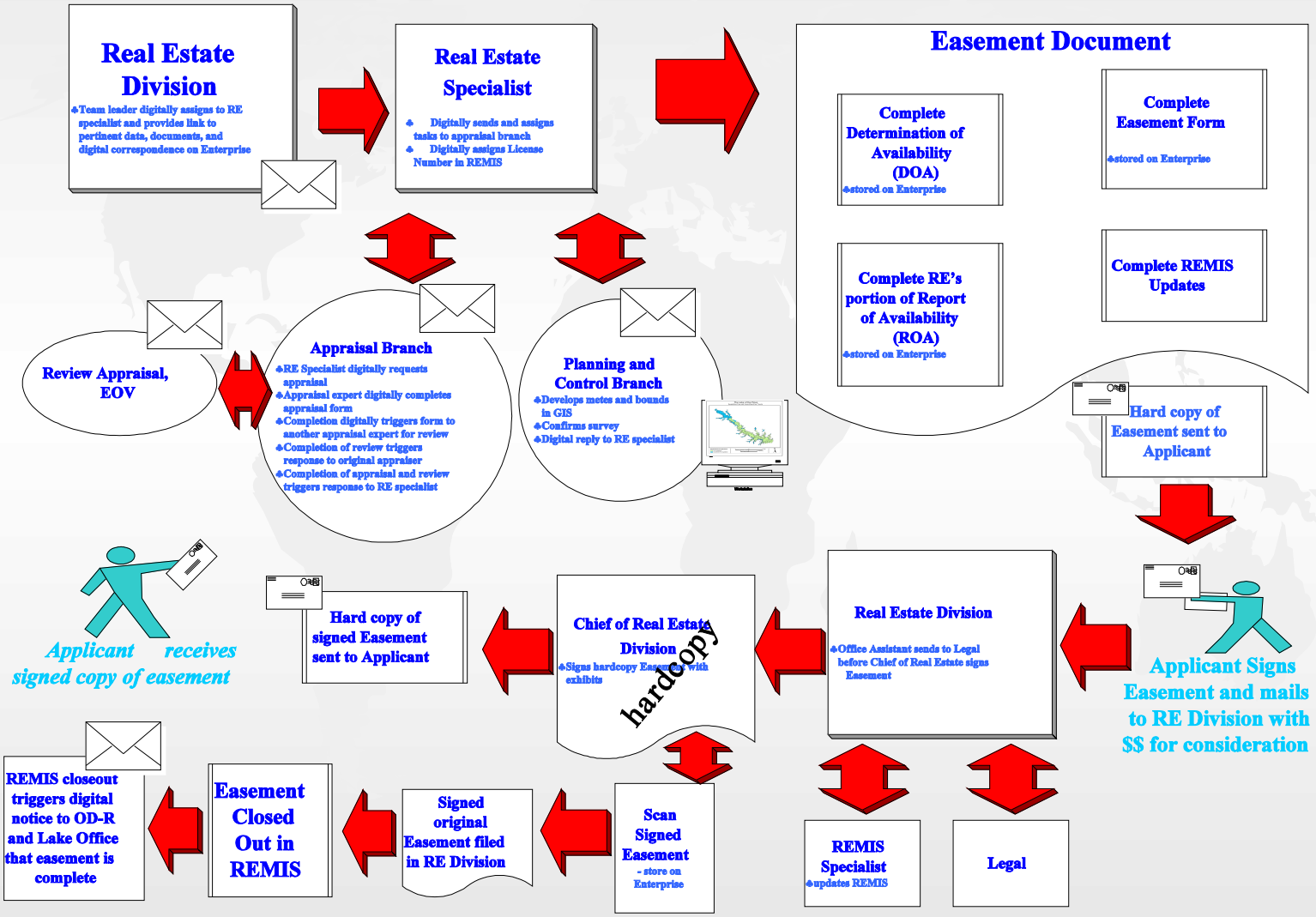
Figure 5. "To Be" Easement Business Process for Real Estate Division

Thursday, September 12, 2002


Real Estate Division
♣Team leader digitally assigns to RE specialist and provides link to pertinent data, documents, and digital correspondence on Enterprise
Real Estate Specialist
♣ Digitally sends and assigns tasks to appraisal branch
♣ Digitally assigns License Number in REMIS
Easement Document
Complete Determination of Availability (DOA)
♣stored on Enterprise
Complete Easement Form
♣stored on Enterprise
Complete RE's portion of Report of Availability (ROA)
♣stored on Enterprise
Complete REMIS Updates
Hard copy of Easement sent to Applicant
Review Appraisal, EOV
Appraisal Branch
♣RE Specialist digitally requests appraisal
♣Appraisal expert digitally completes appraisal form
♣Completion digitally triggers form to another appraisal expert for review
♣Completion of review triggers response to original appraiser
♣Completion of appraisal and review triggers response to RE specialist
Planning and Control Branch
♣Develops metes and bounds in GIS
♣Confirms survey
♣Digital reply to RE specialist
Applicant receives signed copy of easement
Hard copy of signed Easement sent to Applicant
Chief of Real Estate Division
♣Signs hardcopy Easement with exhibits
hardcopy
Real Estate Division
♣Office Assistant sends to Legal before Chief of Real Estate signs Easement
Applicant Signs Easement and mails to RE Division with $$ for consideration
REMIS closeout triggers digital notice to OD-R and Lake Office that easement is complete
Easement Closed Out in REMIS
Signed original Easement filed in RE Division
Scan Signed Easement - store on Enterprise
REMIS Specialist
♣updates REMIS
Legal